THE

# FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 55 Thursday, September 10, 1936 No. 1047

PUBLISHED WEEKLY

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

**Institute of British Foundrymen**

PRESIDENT: 1935-36
H. Winterton, "Moorlands," Milngavie, Dumbartonshire.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands: A. A. Timmins, A.I.C., 21-23, St. Paul's Square, Birmingham.
East Midlands: B. Gale, "Parkdale," Boulton Lane, Alvaston, Derby.
Lancashire: J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.
London: H. W. Lockwood, Stewarts and Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2.
Middlesbrough: D. R. Kinnell, Chas. P. Kinnell & Company, Limited, Vulcan Ironworks, Thornaby-on-Tees.
Newcastle-upon-Tyne: W. Scott, Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, Close Works, Gateshead-on-Tyne.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Sheffield: T. R. Walker, B.A., "The Priory," Oughtibridge, near Sheffield.
Wales and Monmouth: J. J. McClelland, 12, Clifton Place, Newport, Mon.
West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.

Burnley: W. Haworth, 37, Westbourne Avenue, Burnley, Lancs.
East Anglian: J. L. Francis, 53, Cromer Road, Ipswich.
Falkirk: H. McNair, "Braewick," Larbert Road, Bonnybridge, Scotland.
Lincoln: E. R. Walter, M.Sc., The Technical College, Lincoln.
Preston: P. Leyland, 7, Ashley Terrace, Farington, Lancs.

**The Institute of Vitreous Enamellers**

President: Dr. J. W. Mellor, F.R.S., Sandon House, Regent Street, Stoke-on-Trent.
Chairman: W. H. Whittle, W. H. Whittle, Limited, Eccles, near Manchester.
Hon. Secretary: Miss E. Christine Elliot, 49, Wellington Street, Strand, London, W.C.2.

**National Ironfounding Employers' Association**

President: J. Smith, Smith & Company (South Shields), Limited, Nile Street, South Shields.
Secretary: Harold G. Judd, C.B.E., 8, Frederick's Place, London, E.C.2.

**Foundry Trades' Equipment and Supplies Association**

President: G. T. Lunt, "Briardene," Newbridge Avenue, Wolverhampton.
Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

**Welsh Engineers' and Founders' Association**

President: W E. Clement, Morfa Foundry, New Dock, Llanelly.
Secretary: J. D. D. Davis, 9, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION
The Registered Office and Laboratories of the B.I.C.R.A. are:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
*Telephone: Central* 1885. *Telegrams: CIRA*
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk
*Telephone:* 332

## Contents

| | PAGE |
|---|---|
| Surface Development | 191 |
| The International Congress | 191 |
| Pulverised Fuel Equipment at a Derby Foundry | 192 |
| The Manufacture of Cast-Iron Pipes | 195 |
| Skeleton-Pattern Moulding for Pipes | 196 |
| Report on Recommended Practices for Sand Cast Magnesium Alloys | 197 |
| The Baby Cupola | 200 |
| Ni-Resist for Internal Chills | 204 |
| Correspondence | 204 |
| Safety Goggles | 204 |
| I.V.E.: Annual Conference | 204 |
| The Week's News in Brief | 206 |
| Trade Talk | 206 |
| Company Reports | 206 |
| Contracts Open | 206 |
| New Companies | 206 |
| Output of Pig-Iron, Steel and Finished Products | 206 |
| Personal | 206 |
| Obituary | 206 |
| Forthcoming Events | 206 |
| Raw Material Markets | 208 |
| Publication Received | 208 |

## Surface Development

Only a few weeks ago, we made some propaganda for increased activity in the direction of the ascertainment of reliable data on the surface structure of various sorts of cast iron. This knowledge is wanted in connection with heat-treatment, heat and corrosion resisting problems, machineability, nitrarding, welding, vitreous enamelling, plating, pickling and general surface metallurgy. Laissus has indeed done some remarkable work in producing from cast iron what is probably the hardest metallic surface ever created. Certainly, he had recourse to beryllium, which is as yet extremely expensive, but so was aluminium on its isolation and for many years afterwards. Much interesting work has been done by French metallurgists in cementing iron and steel with many different elements, whilst in England Hurst has largely perfected the nitrogen surface treatment of cast iron. Another very important phase of this surface metallurgy question is in the spun-pipe process, where a spray of powdered ferro-silicon precedes the flow of iron along the die, with the avowed object of beneficially influencing the skin of the casting. Here conditions are standardised and modifications are effected upon known material, but it represents an isolated case. Hurst, too, for his surface treatment had to develop from a mass of experimental work an ideal basic composition upon which to work. A series of utilitarian irons should be chosen, and these should be cast into dry, green and chilled moulds, and against various types of cores. Moreover, the finish of the moulds should be varied and correlated with the surface structure. From the other end work should be carried out to ascertain which type of surface structure, physical and metallographical, is the best for cementing, vitreous enamelling, welding, plating and so forth. Then, having determined which is the best type of structure for any given after-process, experiments should be directed towards increasing its depth in the cheapest possible manner. A number of special processes have recently been developed which have for their object the improvement of various properties of cast iron, yet we doubt whether their exploiters could say exactly what type of surface structure was the best. A certain amount of reliable empirical information exists, especially amongst the malleable founders, as to the potentialities of various types of surfaces, and defects have been classified, but naturally enough this appertains to a restricted section of the industry. There are real prizes to be obtained from the successful prosecution of this class of research. The steel trade is rapidly developing stainless-clad steels, and it is now up to the foundry industry to create a range of stainless-clad cast-iron castings.

## The International Congress

Plans for the International Congress at Düsseldorf are now complete. A party arranged by the Cast Iron Research Association, we understand about sixty strong, left on Tuesday for some pre-Congress works visits, and the party organised by the Institute of British Foundrymen—another thirty or so—will leave next Monday. The printed programme of the Congress proper shows that the arrangements fall into three parts. The Congress itself follows the familiar lines of works visits and the presentation of Papers and their discussion. Over thirty Papers are due to be read, divided into groups and presented in three duplicate sessions. They relate to the metallurgy of cast iron, moulding sands, steel castings, non-ferrous castings, and foundry practice. Eight nations will contribute Papers, the seven other than those of Germany being Exchange Papers. For most visitors it will not be possible to see more than two of the ten works, but the difficulty of devoting more than two half days during a Congress to plant visits and of making more than one visit on each seems insuperable. Our impression is that the works visits are far more popular than technical sessions when overseas congresses are held.

The second part of the arrangements made concerns the Foundry Exhibition, to be held in Düsseldorf and due to be opened by Dr. Shacht on September 17. We shall describe any special or novel features of the exhibits. The third part of the arrangements concerns a post-Congress tour of works and tourist-centres in Germany. This extends over no less than seventeen days and is very ambitious. It essays to give the visitor a survey of the industrial and scenic resources of the country, and of its history and culture. Proceeding from Düsseldorf by way of Siegen and Marburg, it goes through the Harz mountains to Magdeburg and Berlin. The tour continues to Dresden and Freiberg, and thence to Nuremberg and Munich, with a side trip to the Bavarian alps where the Olympic winter games were held. Then Stuttgart, Heidelberg and Mannheim follow, the tour ending by way of the Rhine, to Coblenz. Attractive as this tour is, we are inclined to think that few business men will be able to spare the time for such a lengthy stay.

# Pulverised Fuel Equipment at a Derby Foundry

At the extensive works of Ley's Malleable Castings Company, Limited, Derby, pulverised fuel firing is employed in the melting furnaces and annealing ovens in the foundries, and also for auxiliary firing in the boiler house in the works power station. The boilers are normally heated by the waste gases from the furnaces, the pulverised fuel supply being utilised when sufficient waste heat is not available.

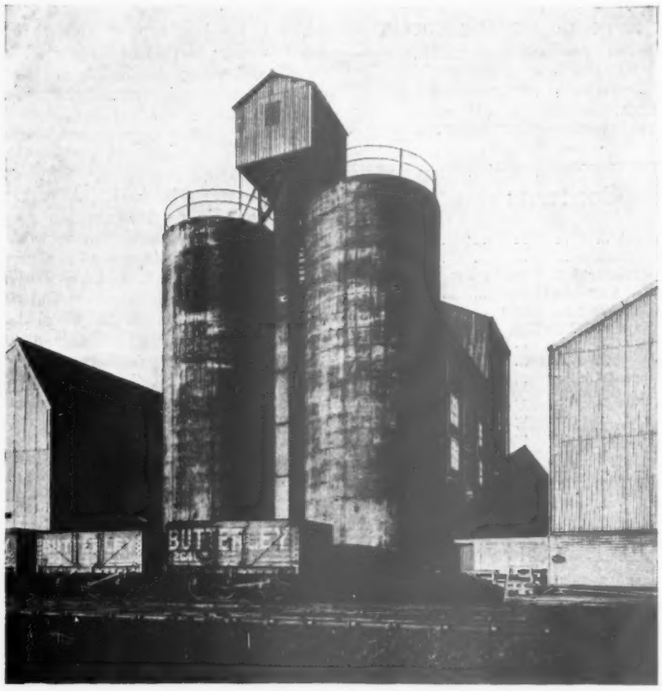


FIG. 1.—RAW COAL SILOS, 50 FT. BY 16½ FT. INTERNAL DIAMETER, AND A CHAIN-AND-BUCKET ELEVATOR AT THE FOUNDRY OF LEY'S MALLEABLE CASTINGS COMPANY, LIMITED, DERBY.

The metallurgical plant consists of six melting furnaces, twenty-four annealing ovens, and four reheating furnaces. The generating plant consisted originally of a 300-kw. turbo-generator; two 1,350-kw. turbo-generators have since been added. There are two complete pulverised fuel handling and storage plants, both of which were supplied by Fraser & Chalmers Engineering Works (proprietors, the General Electric Company, Limited), Erith, Kent.

The latest pulverised fuel plant supplies two melting furnaces, eight annealing ovens, two reheating furnaces, and one of the waste heat boilers (when auxiliary firing is required). A general lay-out is given in Fig. 4, from which it will be seen that there are three main sections—raw coal storage, drying and pulverising, and pulverised fuel distribution, each with its associated handling and other equipment. The whole plant is electrically operated, the motors and control gear having been manufactured and supplied by the General Electric Company.

### Raw Coal Storage

Raw coal, consisting of 1½ by ¾ in. washed smalls, containing about 15 per cent. moisture, is unloaded from the trucks into a 10-ton receiving hopper, fitted with a grid to prevent the entrance of foreign matter. A 20-in. apron feeder leads from the hopper discharge to the foot of a bucket elevator between two 200-ton silos (Fig. 1), to the top of which the coal is lifted at the rate of 15 tons an hour; here a three-way valve enables the coal to be discharged into either silo or into a shute leading to a 20-ton raw coal bunker. Each silo is built of reinforced concrete, the internal measurements being 50 ft. high by 16½ ft. diameter, and conical bases are provided to allow the accumulated water to drain off. Coal is withdrawn at the bottom through three openings with rack-and-pinion gates, beneath which run two screw feeders (one for each silo) leading to the base of the elevator. Thus, the raw coal bunker can be filled either directly from the receiving hopper or from the storage silos as required.

The apron feeder and the elevator are driven by 5-h.p. motors, and the screw feeders by 2-h.p. motors; the starters are interlocked to ensure that the elevator is started before the feeders and also that the apron feeder and screw feeders are not in operation simultaneously.

### Drying and Pulverising

In order to prevent any tendency of the pulverised product to pack in storage, and also to enable the grinding mill to give its maximum output with minimum current consumption, it is necessary to dry the raw coal. It is therefore extracted from the bunker by means of a variable speed reciprocating screw feeder (a duplicate feeder is installed as a standby) and fed at the rate of 2 tons an hour to a dryer of the Ruggles-Coles type (Fig. 2). This dryer reduces the moisture content from 15 per cent. to 2 per cent., and is fed with hot gases generated in a small hand-fired furnace burning about 45 lb. of coal per ton of coal dried.

The fines carried away by the exhaust gases from the dryer are recovered by passing them (by means of the fan seen in the centre background of Fig. 2) to the top of a Cheltnam "Micron" precipitator (Fig. 5), which is capable of dealing with 1,800 cub. ft. of gas per minute. This type of precipitator has been developed by Fraser & Chalmers Engineering Works to give dry separation with high efficiency and selective operation, ensuring that the larger particles are entirely eliminated, and without the need for constant attention and maintenance. The dust precipitated is fed through a dust pipe and rotary air lock (driven at 50 r.p.m. by a 1-h.p. back geared motor) to join the dry coal at the discharge end of the dryer, while the cleaned gases pass to the atmosphere through a stack pipe.

The dryer equipment is provided with a 12-h.p. motor driving line shafting, from which are driven (*a*) the dryer (through a countershaft and belting and bevel and spur gearing), (*b*) the fan (through belting), and (*c*) the screw feeders (through bevel gears, and a second countershaft). The arrangement can be followed by reference to the general lay-out given in Fig. 4 and also to Fig. 2.

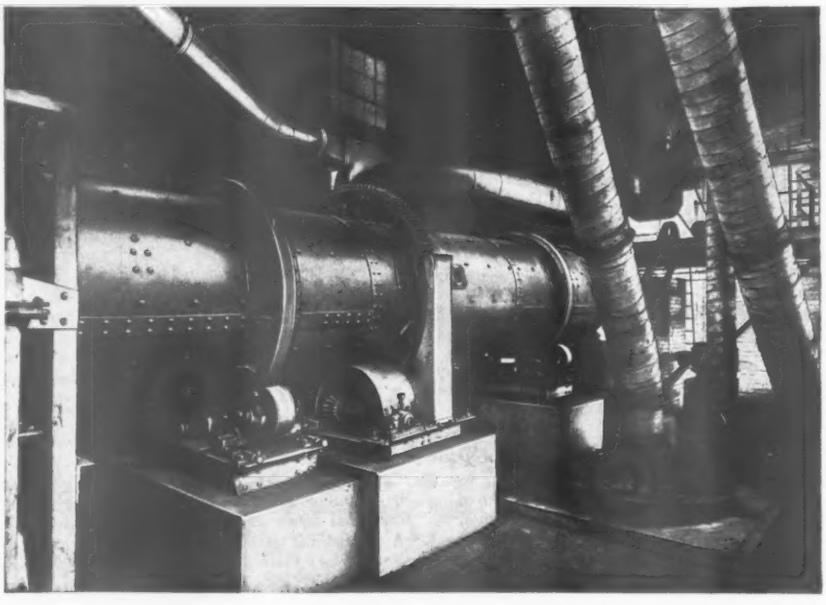


FIG. 2.—RAW COAL DRYER, SHOWING ALSO FAN AND ONE OF TWO SCREW FEEDERS.

The coal from the dryer is now ready for pulverising and is passed through an Avery automatic weighing machine to a surge hopper, from which an adjustable reciprocating screw feeder delivers it to an air-swept ball mill of the Har-

dinge type (Fig. 3), 6 ft. diameter and 36 in. long. The mill capacity is 2 tons of coal an hour, and it reduces the coal from 1½ by ¾ in. to a fineness such that 85 per cent. will pass through 200 B.S.S. mesh; it runs at 26 r.p.m.

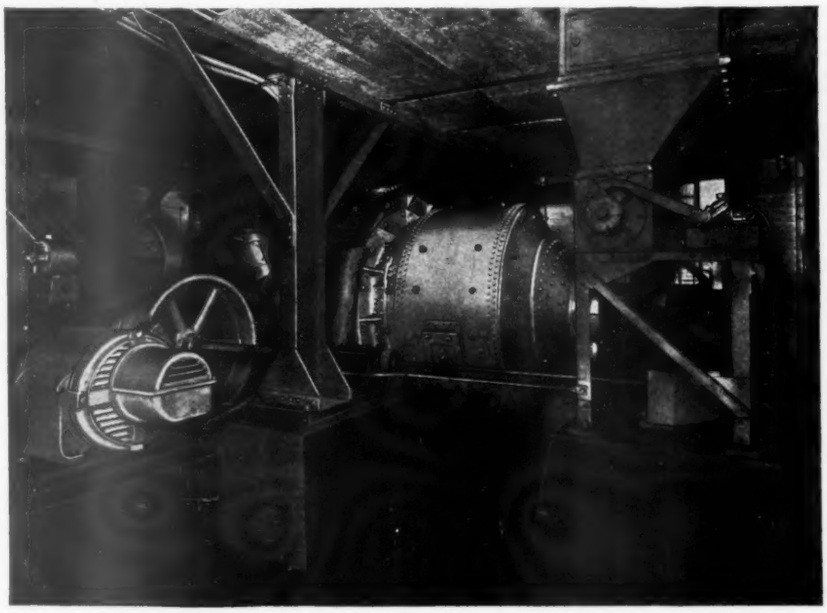


FIG. 3.—HARDINGE BALL MILL; AT THE BACK ON THE LEFT IS THE MILL FAN.

and (with the screw feeder) is geared to a countershaft driven through V-belts by a 60 h.p. 725-r.p.m. slip-ring motor. The coal-laden air is extracted by a fan (driven by a 20-h.p. motor seen behind the main motor in Fig. 3) and delivered to the top of a cyclone separator, where the coal is settled out and passed through a rotary air-lock and a two-way shute into one of two 15-ton storage bins.

The mill is fitted with air classifying equipment and is operated with a closed air circuit, which has been proved by experience to be the best method of preventing over-grinding; the cleaned air from the cyclone returns to the mill *via* a classifier. The air circuit is provided with a slight vent to compensate for leakage on the suction side, and the plant is kept free from dust by tapping this vent to a Roots blower; part of the air is thus taken to a bag filter, where any dust entrained in it is recovered and delivered through an air lock to the storage bins. The blower is driven through V-belts by a 7½-h.p. motor.

The control gear on the drying and pulverising plant is interlocked so that the fan and the cyclone and filter air lock must be started first, followed by the mill itself, then the precipitator air lock, and last of all the dryer and its feeders; an isolating switch is provided to allow the drying plant to be run independently when required.

### Pulverised Fuel Distribution

The pulverised fuel is distributed on the Fraser & Chalmers system, in which primary air is blown through pipe lines, the coal being sucked in at suitable points. Three fuel lines, each containing an injector, are provided, the longest being 440 ft. long; two lines lead to 20-ton melting furnaces and one to the waste heat boiler, enabling the latter to be provided with an auxiliary supply of fuel when the temperature of the flue gases is not high enough to generate the steam required.

The primary air supply is provided by two fans, each of which has a capacity of 3,400 cub. ft. per min. at 21 in. W.G.T.H.; these fans discharge into a header feeding the injectors through suitable control valves. Eight annealing ovens and two reheating furnaces are fed from a further circulating main, through which air saturated with coal dust is passed by one or two blower fans (Fig. 6), each having a capacity of 1,750 cub. ft. per min. at 25 in. W.G.T.H.; the annealing line can be vented to the bag filter so that the whole system can be emptied of coal when necessary. Fig. 6 shows the three injectors and the oven pipe line beneath.

The whole fan equipment is in duplicate (all four units are seen in Fig. 6), and suitable cut-off valves are provided to allow of one fan of each pair to be cut out in normal operation, though immediately available in an emergency. The primary air fans are driven by 22-h.p. motors, and the blower fans by 18-h.p. motors.

The pulverised coal for the fuel lines is fed through flexible pipes from three 8-in. feed screws at the bottom of each storage bin (Fig. 7), each feed screw being driven through gear box and roller chain by a 1½-h.p. variable speed d.c. motor, 500/1,500-r.p.m.; the capacity of each screw ranges from 1,200 to 3,600 lbs. per hr. depending on the speed; by substituting chain drives of different ratio the maximum capacity can be reduced to 1,700 lbs. per hr. Four flexible connections (seen in Figs. 6 and 7) are provided and are interchangeable, allowing any feed

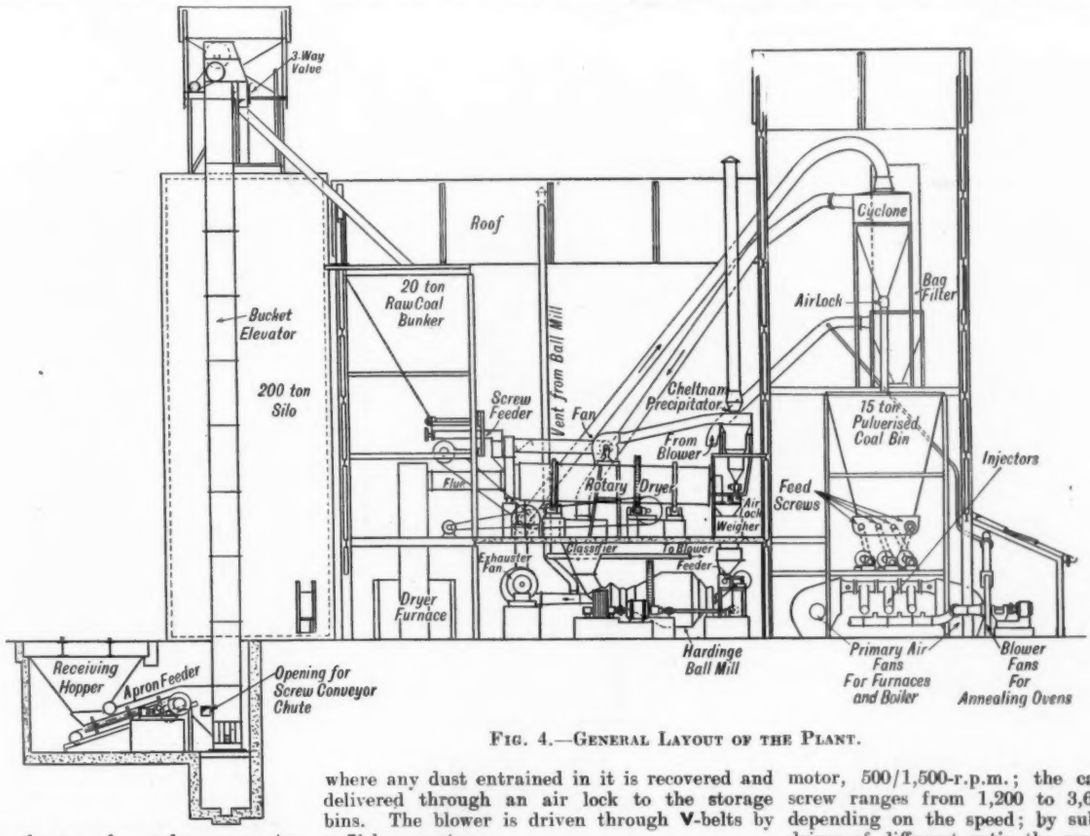



FIG. 4.—GENERAL LAYOUT OF THE PLANT.

screw to discharge into any injector or circulating main as required. As each feed screw operates independently this is a very flexible arrangement, giving a wide range of feeds and alternative feed methods; Fig. 6 shows one feed screw connected to a furnace line, one to the oven line, and two to the boiler line.

The feed screw motor starters are interlocked with those of the fan motors, so that if the latter are shut down for any reason the feed screw motors shut down automatically, and *vice versa*.

Each storage bin is also provided with a 10-in. feed screw equipped with a 2-h.p. variable speed motor; these screws discharge outside the building, allowing the bins to be emptied into containers on adjacent rail tracks when required.

### Electrical Equipment

The constant speed drives are equipped with protected type a.c. motors running at 720, 950 or 1,450 r.p.m., and supplied at 400 volts, three-phase, 50 cycles, from the works supply. The Hardinge mill is driven by a slip-ring motor, equipped with an air-break rotor starting panel. With this exception, squirrel cage motors are employed throughout; standard machines are used on the screw feeders under the silos and the rotary air-locks, and high torque motors for the fans, Roots blower, dryer plant, and raw coal feeder and elevator. Motors below 10 h.p. are equipped with direct-to-line contactor starters, and the larger machines with stator resistance starters. In all cases the starters are push-button operated, and additional push-buttons are provided for remote control from convenient points.

Variable speed drives for the pulverised fuel feed screws are provided by totally enclosed shunt wound motors fed at 220 volts d.c. from the works supply. Each motor is equipped with

(*Concluded on page* 206.)

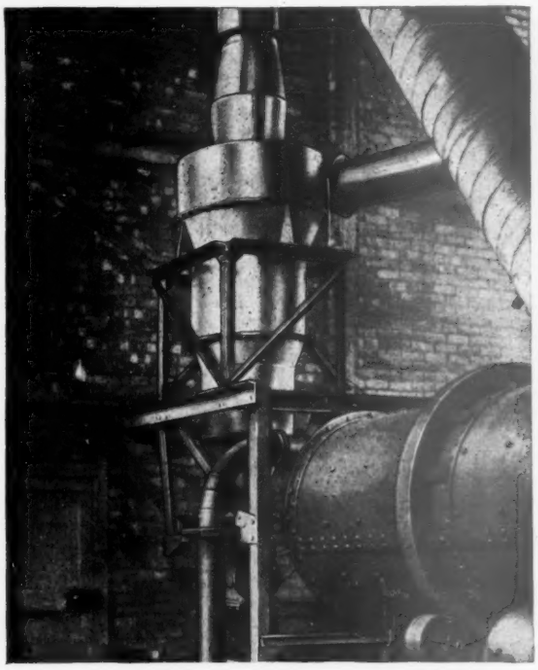


FIG. 5.—FRASER & CHALMERS CHELTNAM "MICRON" PRECIPITATOR FOR CLEANING EXHAUST GASES FROM RAW COAL DRYER (SEEN ON THE RIGHT).

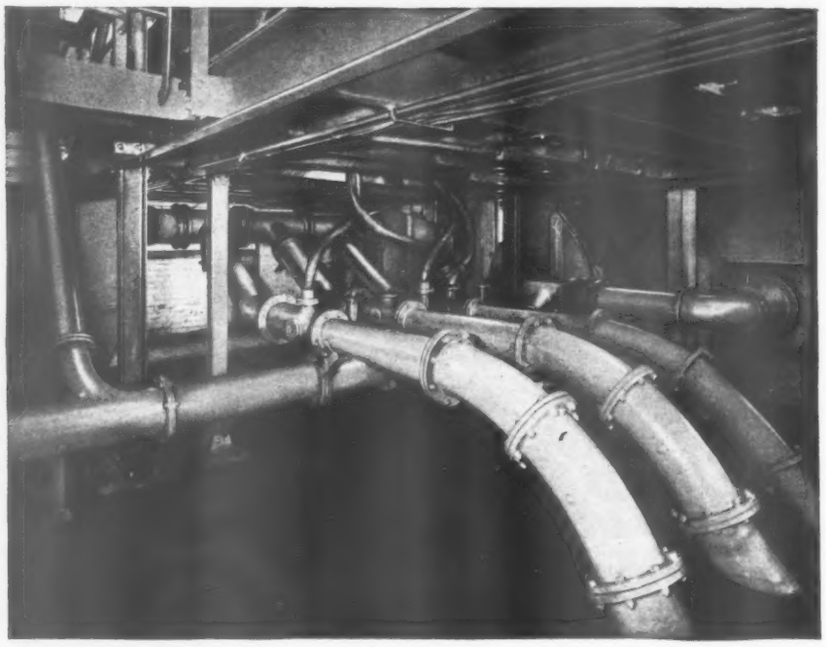


FIG. 6.—FUEL DISTRIBUTION LINES AND ANNEALING LINE WITH FLEXIBLE CONNECTIONS FROM PULVERISED COAL FEEDERS (SHOWING ALSO PRIMARY AIR FANS AND BLOWER FANS).

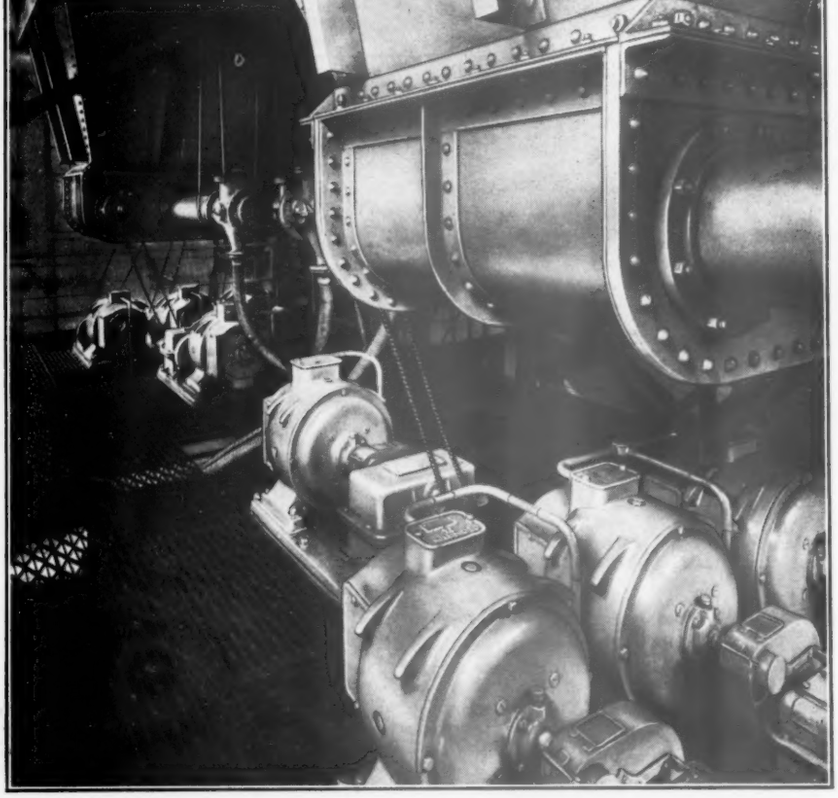


FIG. 7.—EIGHT VARIABLE SPEED D.C. MOTORS 1½ H.P. AND 2 H.P., DRIVING FEED SCREWS FROM PULVERISED FUEL STORAGE BINS.

FIG. 8.—MOTOR CONTROL GEAR.

# The Manufacture of Cast-Iron Pipes

At the last meeting of the Sheffield Branch of the Institute of British Foundrymen, MR. W. WOODHOUSE, F.I.C., chief chemist of the Stanton Ironworks Company, Limited, read a Paper on "The Manufacture of Cast-Iron Pipes."* The discussion which followed was opened by MR. A. WHITELEY (Branch-President), who said that he personally had been fascinated by the way in which the Stanton Company managed to handle and control molten iron in the manufacture of their pipes.

### The Ardelt Process

MR. J. ROXBURGH, speaking with reference to the Ardelt process of casting pipes vertically, assumed that in blacking the moulds a spraying process was used. He would like to know what fuel was used for the burners for drying the moulds; he also noted the number of runners that were used for the pipes. He assumed that the core was centred in the head by means of chaplets. With regard to the cupola practice, would Mr. Woodhouse indicate the diameter of the cupola; the weight of the metal charge; the weight of the coke in the separating charge, and what he incorporated in his mixture?

Regarding the Delavaud process, the author did not mention the coating that was applied to the steel mould, and the speaker would like that information. Another interesting point was the removal of chill by annealing. Mr. Roxburgh wondered whether, in casting in a steel mould, with iron of a composition such as was used for the manufacture of pipes, it was possible actually to throw a skin-chill, *i.e.*, a white iron skin, on the pipe, or whether it was just a question of densening the outside of the pipe, which, of course, could be somewhat removed in the annealing process. He felt that if an actual skin chill was obtained, it would be difficult to remove the white iron coating by annealing for a short time.

### Special Bends

The speaker was very interested in the plant at the Holwell works which Mr. Woodhouse mentioned. He had never been connected with any repetition foundry which manufactured pipes, but he had been a jobbing founder, and made different kinds of pipes in small numbers; and it was interesting to him to find in that particular plant green sand cores were made in core boxes and the fabricated grid was used for "specials." One firm he was connected with used the method whereby the core iron were made in pieces and bolted together, and after casting the bolts were undone, the core iron dissembled, and this was used many times.

MR. WOODHOUSE, in reply, said that for blacking the body mould they used a watering can with a special spout, which sprayed the blacking on to the sides of the mould; this was done from the top. The cores were sprayed with a blower sprinkler, and the moulds were dried in core ovens, which were heated by producer gas. Producer gas was also used for the normalising furnace. With regard to the runners for the pipes, the core was centred at the bottom in the socket and at the top there were four cakes put round, with holes in between forming runners for the metal. Chaplets were not used.

### Delavaud Process

The diameters of the cupolas varied; cupolas were used which melted six tons, ten tons and fifteen tons per hour, respectively, and naturally the charges varied accordingly. With a cupola 56 in. diameter the charge was 50 cwt. and the mixture was about 60 per cent. pig and 40 per cent. scrap. The first coke charge was put in to 18 in. above the tuyeres.

MR. ROXBURGH: "And the separating charge?"

MR. WOODHOUSE replied that a 10 to 1 coke ratio was used between the charges. He also said there was no coating on the steel moulds, but a thin layer of ferro-silicon was deposited on the mould during each cast, by means of a tube under the runner trough, the powder being fed by a special patented apparatus.

With regard to the chill, it was very small indeed in the pipes. It was not white iron, but the metal was in the austenitic form in the molten state, and in the cooling it remained in the austenitic form as austenitic cementite. It was actually a white skin, of austenitic cementite structure, and in the normalising that was broken down to martensite, pearlite, and ultimately ferrite and graphite. The silicon was round about 2½ per cent. The figures for the spun metal were: Silicon about 2½, sulphur 0.08, phosphorus 0.8, manganese 0.3, and total carbon about 3.4 per cent. In cast in dry sand pipe the silicon was 2.4 to 2.6, sulphur about 0.08, phosphorus 1.3, manganese about 0.3, and total carbon 3.3 to 3.5 per cent.

### Sulphur-Manganese Balance

MR. R. C. TUCKER, referring to Mr. Roxburgh's questions regarding the composition of the spun pipe and the sand-cast pipe, said what particularly interested him from a theoretical point of view was the composition of the spun pipe. Mr. Woodhouse had told them that the manganese content was 0.3 per cent., and the sulphur 0.08 per cent. That was perhaps below the proper ratio for manganese-sulphur for avoidance of chill. He wondered whether, if the manganese was raised to 0.4 per cent., the chill effect that Mr. Woodhouse got on the pipe would be ameliorated. One knew that, in roll manufacture, the control of the manganese-sulphur ratio was important.

Mr. Tucker said he was interested in the photograph which Mr. Woodhouse showed, comparing the cast condition, and he believed, the annealed spun condition. The structure of the spun pipe seemed to have far more white iron in it than could be accounted for by any small distribution of phosphide, and he strongly suspected the presence of a considerable amount of cementite. He did not know whether Mr. Woodhouse would give them any further information as to the details of that spun layer structure. It was a fact that the solid solution of carbon in iron, which would be in the outer layers, would possibly be broken down in any normalising process, but he thought the annealing process which was given to those pipes at about 925 deg. C. was a rather rapid malleablising process, and that would account for the beautiful stretching of the ring specimen they saw, which was cut from the outside. As one knew, the presence of silicon increased this rapid breakdown, but of course the presence of primary graphite would prevent a good "malleable" elongation.

### Skin Structure and Ferritic

MR. WOODHOUSE said he hoped he had not emphasised the chill effect, because it was very small indeed.

MR. TUCKER: It does have a very great effect on the impact value of the pipes.

MR. WOODHOUSE: Yes, but the white portions which were noticed in the spun photomicrograph were not cementite at all. There is no cementite in the pipe, except in that very slight amount of chill. The structure which was seen was very low ferrite, phosphide eutectic, and graphite, and the white irons were definitely ferrite.

MR. TUCKER: How has the author accounted for the presence of that ferrite? Is it due to the malleablising effect?

MR. WOODHOUSE: Agreed. One has got the ferrite there even before normalising, but it is enhanced to a certain extent.

MR. TUCKER said that in normal sand casting of that type one was likely to get, with 2½ per cent. silicon, about 10 per cent. of ferrite, with a good deal of pearlite. The ground mass would be mainly pearlitic. If they were going to densen that iron up against a chill, any ferrite would be repressed and the combined carbon would be raised. A little of the combined or dissolved carbon would also be destroyed by the normalising process, and he would like to know whether the normalising process did actually precipitate so much graphite that ferrite would be left.

MR. WOODHOUSE: The spun process itself brings about the smaller structure of the graphite, the wider distribution of it in comparison with the bigger flakes of graphite which are obtained in the ordinary sand cast process.

### Size of the Pipe Industry

MR. J. B. ALLAN said the lecture had been particularly interesting to one who was also concerned in the same business. The whole business of pipe manufacture, whatever process was used, was extraordinarily interesting from many standpoints, one in particular being that it generally required the greatest tonnage of any castings that were made at the present time, with the possible exception of motor cylinder blocks. Historically, pipes represented the most continuous manufacturing process which had ever existed, and it was very remarkable that, until the present time, the processes had remained very much the same. Great changes had recently been made, however, and many different processes were now used. Mr. Woodhouse's company was to be congratulated on the very wonderful amount of pioneer work they did in the production of the spun pipe, which was being used in increasing quantities every day. There was no doubt whatsoever that the old sand-cast pipe, however cast, was rapidly becoming obsolete. So far, it had not been possible to manufacture the larger sizes of pipe by the spun process. Mr. Woodhouse had mentioned 21 in., and, so far as he knew, in this country there was nothing bigger than 24 in. made. In America they were made up to 36 in. by centrifugal methods. The trouble here, however, was not a technical one, but the lack of demand for the large pipes. It would not be difficult to make a plant that would produce the larger sizes of cast-iron pipes centrifugally, but it would need a greater demand than at present existed.

MR. TUCKER said he had noticed in technical literature recently reports of modifications of the Delavaud process, in which a fine powder was blown on to the mould, just in advance of the metal stream. He would like to know if Mr. Woodhouse had any experience of that process for the purpose of eliminating the chill. The lecturer had mentioned a spout which was pushed into the mould and tipped over. He believed the latest process in America was to blow the fine powder, but he did not know whether it was adopted in England.

MR. WOODHOUSE said he believed it was done in America. THE FOUNDRY TRADE JOURNAL of January 2 and 23, 1936, gave a full account of the method; a modification of which was used in England.

### Vote of Thanks

MR. S. LEETCH, in proposing a vote of thanks to Mr. Woodhouse, said Mr. Woodhouse had given them much information, and he wondered how many of those present could think of putting down a plant on similar lines. MR. F. WHITEHOUSE seconded the vote of thanks, which was carried; MR. WOODHOUSE briefly replied.

F

* FOUNDRY TRADE JOURNAL, Vol. 54, p. 357.

# Skeleton-Pattern Moulding for Pipes

By J. H. EASTHAM

A marine-engine discharge pipe casting 16 in. in diameter, 10 ft. long, and weighing approximately 13 cwts., is shown in Fig. 1. Its general design is best described as a 90-deg. elbow attached to a 15-deg. offset; the elbow flange to connect with the low-pressure cylinder, the elongated offset end discharging exhaust steam into the horizontal style condenser.

Early practice favoured the assembly of two separate castings, flanged and bolted together at the dotted line, a system which made things easy for the foundry department, but increased machining and assembly costs. The decision to

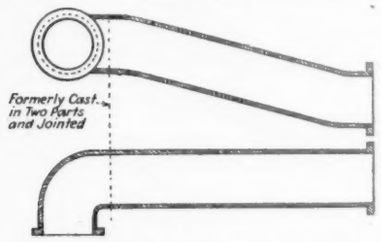



FIG. 1.—MARINE ENGINE DISCHARGE PIPE, 16-IN. INSIDE DIAMETER, 10 FT. LONG. THE UPPER VIEW SHOWS THE POSITION IN WHICH THE PIPE WAS MOULDED.

economise in those departments put a different complexion on the matter, particularly when it is realised that orders for marine engines are usually booked one at a time, with scarcely any two alike either in horse-power or design. Standardisation of patterns is, therefore, possible to a limited degree only, and the number of instances where existing patterns or coreboxes can be altered to suit a new order is very limited. Merging the two castings, and thus creating a hybrid design, would, if ordinary procedure had been followed, have made the production cost much higher in both patternshop and foundry. In order, therefore, to maintain the saving in the machine shop, a preliminary conference as to ways and means from the blueprint stage became advisable.

### Skeleton Arrangement Used

Instead of a highly-finished full pattern and pair of expensive coreboxes, to be used once, with no prospect of a repeat order, a skeleton arrangement in both coreshop and on the moulding floor was decided on, the casting to be moulded in the position indicated in the upper view in Fig. 1. A sweep frame of 1-in. timber, following the contour of the projected pipe casting, and fitted with reversible battens designed to permit the frame to stand in accurate position on a machined plate—either side up as needed—was laid in a prepared bed sunk in the foundry floor, that portion of the frame intended to form the elbow being accurately levelled in line with the shop floor. Inside and under the frame, sand was packed to a degree of density necessary to prevent swelling when receiving molten metal, and yet soft enough to be compatible with the use of a "dabber stick."

The inside of the frame was then strickled out to its full depth of 1 in., and the core iron moulded to "fishbone" design. The prongs following the curve of the body were shaped by using a pointed bar, bent to shape, chalk-marked to indicate the length, and thrust into the sand at the proper distances apart. The frame was then removed, and all parts of the mould below the floor level covered with heavy paper. Sand was then spread over the paper-covered area to a thickness of about 2 in., a number of flat thin plates laid over the whole, and weighted to prevent strain or leak when pouring the metal. The molten iron was introduced into the top or elbow end left open for the purpose. This practice is similar to that used when moulding large cylinder-port core irons, and is shown in detail in Fig. 2.

### Drag Half of Core

When sweeping up the first or drag half of the core, the frame was laid on the machined deck of an oven car and the same light steel plates used to cover the core iron mould were packed under the high portion to form a flat working face. A thin layer of prepared sand was then laid in readiness to receive the clay-washed core iron. The half core was then rammed and swept to shape from the elbow end upwards, as indicated in the composite views of the partially made core in Fig. 3. The frame and packing removed, the half core was black-washed and dried over night, a maximum oven temperature of 230 deg. C. preventing "burning" the surface of the core at this or a later stage.

The following morning, upon its removal from the oven, the core was lifted from the car, turned over on soft sand and empty bag packing, and replaced on the car deck in position to permit the cope half to be swept to shape. As shown in the view of the completed core, Fig. 4, this latter operation was accomplished by reversing the position of the frame, which was then packed up flush with the joint line, a ridge of vent coke laid from end to end, and sand banked over the coke and swept to shape as when forming the lower half. Strickling completed, the frame was removed, and the core checked as to correct diameter by means of a wooden caliper gauge. The whole surface was then black-washed, before the second night's drying to complete the process.

### Pattern Halves Dowelled Together

To simplify matters when moulding the pipe, two halves of a lagged-up skeleton-pattern were dowel-pinned together; the coreprints and flanges were made full, and the lagging blocks—placed reasonably close together to prevent springing—were covered with thin sheet metal bent to the contours of the pipe's outside diameter. This skeleton design, in the case of an order for a single casting of unusual shape, is economical as to time and material, and has the advantage of flexibility, as the lagging blocks and sheet metal covering may be easily taken apart and reconstructed in different design when necessary.

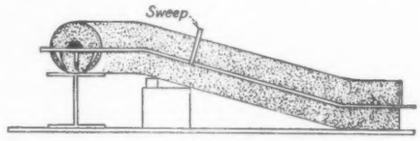



FIG. 4.—COMPLETED CORE BEFORE SECOND DRYING.

The lower half of the pattern was bedded into a pit roughly conforming to its shape, rammed up to the joint line, and a parting made ready for the upper half pattern and the special box fitted to hold that section of the mould. As the view of the assembled mould in Fig. 5 indicates, the cope flask sides were made of plates (cast open-sand) with a joint line following approximately that of the pattern. The same pair of end plates were used for all of the varying sizes, and three differently pitched sets of side plates (or six in all) were found sufficient to cover a wide range. The expense of their separation and reassembly to suit varying shapes was easily compensated for by the saving effected in actual moulding cost, as compared with the intricate work necessary if the pipe had been made in a straight jointed flask.

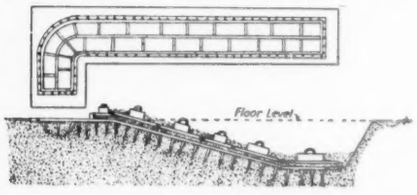



FIG. 2.—PLAN AND SECTION OF DISCHARGE PIPE CORE IRON MOULD.

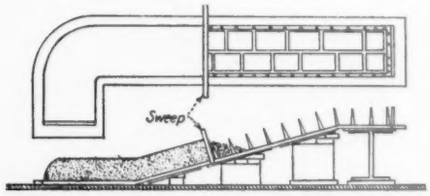



FIG. 3.—DRAG HALF OF DISCHARGE PIPE CORE, PARTIALLY SWEPT.

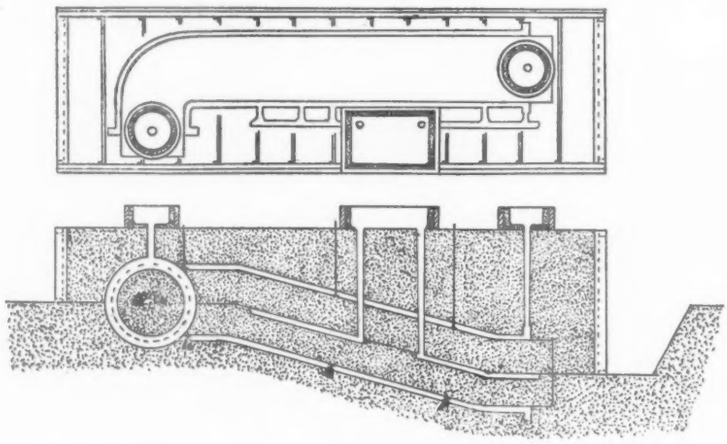


FIG. 5.—ASSEMBLED MOULD IN PLAN AND SECTION, SHOWING GATING, RISERS AND CHAPLET ARRANGEMENT.

### Moulds of Green-Sand Type

The moulds were of usual green-sand type, gated along the joint as shown, with upper and lower chaplets to secure the core in size and number as found necessary. Usually three upper

(*Concluded on page 202.*)

# Report on Recommended Practices for Sand-Cast Magnesium Alloys*

By the Non-Ferrous Division Committee of the American Foundrymen's Association

*(Slightly abridged.)*

## GENERAL RECOMMENDATIONS

### Moulding

*Sands.* — An open moulding sand should be used to offset the lightness of the metal and allow steam and core gases to escape readily. Very satisfactory results are now being obtained from a synthetic sand with American Foundrymen's Association permeability of 50 to 60, prepared by adding 4 per cent. of bentonite to a silica sand graded to 100 to 150 mesh. A small amount of a "sand addition agent" is mixed with the sand in order to inhibit oxidation of the hot magnesium by steam. The better sand addition agents include sulphur, boric acid and certain ammonium salts, particularly the fluorides, used singly or as mixtures. The amount used depends upon the agent selected, the condition of the sand, and the thickness of the cast section.

A 75-25 water-glycol mixture is used as the tempering agent. In practice, the glycol is added to the sand and the tempering completed by the addition of the requisite amount of water. Thorough mulling is essential to ensure uniform distribution of the bentonite, glycol and sand addition agent and to improve the strength and plasticity of the sand. The sand should not be hard-rammed close to the pattern; but as one proceeds away from the pattern, the ramming can be increased to ensure safe handling of the mould without danger of drops. Light ramming improves the permeability of the sand and permits its contraction during the solidification and cooling of the castings. An ability to contract in both moulds and cores is necessary to counteract hot-shortness in the alloys and so minimise the danger of shrinkage cracks. The mould should likewise be freely vented to aid in the escape of gases.

*Facings.*—Special facings are seldom used in the magnesium foundry, although with heavy castings or sand of relatively low permeability it is sometimes advantageous to use a facing containing more of the addition agent, to dust the moulds with finely powdered sulphur, or to surface-dry the mould.

*Gates and Risers.*—Although gating practice varies necessarily with each casting, there are a number of fundamental principles that must be observed. The metal should, in general, enter the mould cavity at a low point with a minimum of splashing or turbulence, since mechanically entrapped gas forms oxide skins in the metal and these, in turn, increase the viscosity of the metal and retard any subsequent escape of gas. In some cases, however, it is advisable to introduce the metal at the centre or top, providing the mould cavity has an incline to break the velocity and is without elevations and depressions that will create a turbulence before the metal reaches the bottom. This procedure often results in a more uniform solidification of the casting, thus helping to eliminate shrinks, cracks, porous sections, and in some cases misruns.

Turbulence, with its resulting evils, is largely overcome through the use of perforated sheet steel skim-gates containing eight to twelve perforations per inch. This screen is placed at the bottom of the sprue, and, in large complicated castings, a second screen is sometimes placed in the runner near the gates. These screens choke the flow of metal, thereby assuring a steady feed into the mould cavity, and also trap oxide skins that form on the surface of the metal during the pouring operation. Wedge gates that are wide and shallow and feed from the bottom of a hump or well, likewise aid in the removal of entrapped air and oxide skins, but are less frequently used now that skim gates are so generally employed.

A number of finger gates are preferable to fewer large ones as they give a better distribution of heat in the casting and also prevent local overheating of the sand and generation of excess gas and water vapour. Similar objectives call for the location of gates on the thinner sections of the castings. Although the specific heat of the metal is high (0.33 avg. specific heat 20 to 650 deg. C.), the specific gravity of the metal is low, so that the total heat per unit volume is low. As a result, total gate area and runners should be of generous proportions to ensure a free flow of metal. Risers should be large and connected as directly as possible to the section to be fed.

Progressive solidification of the metal should be obtained through the use of risers instead of chills wherever the riser will accomplish the same end, and provided it is located so that it does not introduce trouble in moulding and trimming. When chills are used, they may be made from customary materials, such as iron and graphite, although best results are obtained from magnesium alloy chills. They must be clean and dry to avoid blows, and large ones should be perforated to aid in the escape of gas.

*Cores.*—Cores should be made from an open sand containing sulphur, boric acid, and an oil binder. They should be rammed no harder than necessary to ensure retaining their shape before baking, and should be well vented. The oil binder should generate a minimum of gas and should permit the core to soften when contacted by molten metal. The cores are baked at 175 to 260 deg. C. for 20 min. to several hours, depending on the size of the core, after which they are given a graphite-alcohol wash and the alcohol ignited and burned off. Green sand cores should be used wherever possible for smoothness and economy. They are made from the regular heap used for the production of moulds.

***This is the second in a series of recommended practices being sponsored by the Non-Ferrous Division of the American Foundrymen's Association, the first being issued in 1934 (Trans. A.F.A., Vol. 42, pp. 1-26). Although the various practices which are treated are recommended by those considered specialists in the various fields, these practices are not intended as specifications. The alloy numbers have no particular significance other than to differentiate alloys in this particular specification. Whenever possible, these numbers are identified with existing alloy specifications.***

***The publishing of data relative to various alloys and treatment of such alloys by the American Foundrymen's Association does not ensure anyone using such data against liability for infringement of any patents that may now exist or are pending. It should also be understood that the publication of data concerning patented alloys or processes does not constitute a recommendation of any patent or proprietory rights that are involved.***

***In preparing these recommendations, the Division has attempted to collect, through reliable sources, such information as will be of practical use to foundrymen handling non-ferrous alloys.***

### Melting and Pouring

*Melting.*—The "Dow Open Flux Pot Melting Practice" is one of the most widely used melting practices for magnesium and its alloys. It is based on the use of a large bath of a fluid flux that functions in a dual manner. This flux protects the molten metal from the air and furnace gases by completely enveloping it and, thereby, eliminates the dangers usually associated with prolonged holding of metal in the molten state and with overheating. It likewise purifies the metal by washing out non-metallic impurities when the metal and flux are intimately mixed. The flux normally used consists of 60 per cent. anhydrous magnesium chloride and 40 per cent. sodium chloride, and has a specific gravity and surface tension that causes it to float the metal. The main body of flux lies in a pool at the bottom of the pot; but a thin film is formed between the metal and the walls of the pot, and across the top surface of the metal.

Melting pots are made of low carbon cast steel and last for approximately 1,000 hours of service. Pots holding 300 and 600 lbs. of metal respectively are the sizes most generally used and are mounted in gas- or oil-fired brick settings. The charge for the smaller pot consists of 100 to 125 lbs. of flux and 300 lbs. of metal, added in the order named. The flux has a lower melting point than the metal and soon forms a bath to receive the metal as it melts down. The molten charge is now given a thorough puddling to bring metal and flux into intimate contact with each other, and thus ensure complete removal of oxide and other non-metallic impurities. Puddling is done with an open-bowl sludge ladle or with a casting ladle described later. The contents of the pot are then allowed to stand quietly for several minutes in order that the impurities may settle from the metal and flux, and form a sludge at the bottom of the pot. This sludge is removed at regular intervals, generally once a day unless very large amounts of scrap metal are melted.

More metal is added as required to replace that removed in the production of castings. Each new charge is washed in flux as already described. The flux can be used repeatedly, but there should always be enough present so that it can be readily brought to the surface of the metal during the puddling operation, and so that the casting ladle can be cleaned in the bath of flux below the metal, as explained later. Under normal conditions, 1 lb. of flux is required for each 8 to 12 lbs. of metal melted, this ratio depending on whether ingot or scrap is melted. All material added to a pot of molten metal should be carefully preheated in order that absorbed moisture may be completely driven off. The foundry flux is very hygroscopic and, hence, should be stored in covered containers and should not be added to a pot containing molten metal. This hygroscopicity likewise calls for careful preheating of all equipment, such as ladles, thermocouples, iron moulds and sludge pans.

*Alloying.*—Substantially all magnesium castings are now made from the Mg-Al-Mn and Mg-Al-Mn-Zn groups of alloys. Aluminium and zinc alloy so readily that hardeners and special technique are not required. Manganese alloys more slowly and only to a limited extent. It is generally added in the form of a 90-10 aluminium-manganese hardener. The casting alloys normally contain 0.1 to 0.4 per cent. manganese, but since this represents approximately the solubility limit, more time and stirring are

* This report was presented at a session on Non-Ferrous Castings at the 1936 Convention of the A.F.A. in Detroit recently. Many phases of the magnesium foundry practice here described are covered by existing United States patents.

required than when alloying other metals. A 75 to 80 per cent. alloying efficiency for manganese is considered good operating practice. Most of the excess of unalloyed manganese settles to the bottom of the pot, although a few particles of microscopic size remain suspended in the alloy. The alloying ingredients are placed in the ladle and then submerged and gently agitated in the molten magnesium, after which the entire charge is thoroughly stirred.

*Scrap Recovery.*—Massive scrap, such as sprues, gates and risers should be free from adhering sand and other contamination. They can be melted the same as ingot, except that the metal should be more thoroughly washed with flux. Metal skim-gates will cause no harm in the pot and can be dipped out with the sludge. In the case of poor quality scrap, it is good practice to use two pots on the counter-current principle, namely, to melt in the one containing the older and dirtier flux and after a preliminary wash to transfer the metal to the casting pot containing clean flux, and wash again.

Machine shop scrap, such as shavings, borings, chippings, etc., present a different problem, because of the greater ease with which such finely divided metal can be ignited and because of the high ratio of surface oxide to metal. Obviously, this type of scrap should be kept dry and, preferably, free from oil or other cutting compounds. It is melted down at the lowest possible temperature, using plenty of flux and starting with a pot containing some metal in the pasty or semi-molten condition. A shovel full of shavings is then added and quickly stirred into the flux. The heat supply of the pot and the addition of shavings are so controlled that the metal in the pot remains semi-fluid. This low temperature operation practically eliminates any loss due to burning and gives maximum coalescence of the metal.

When sufficient shavings have been added to fill the pot, the charge is gently stirred to complete coalescence and the temperature then raised to 705 to 730 deg. C. for the regular puddling or washing operations. The pot contents are now allowed to stand quietly for a few minutes to allow the sludge to settle, whereupon the metal is poured into ingots or transferred to the casting pot. If the melting and purification of scrap is conducted properly, the recovered magnesium alloy is equivalent to virgin metal. Contamination by foreign scrap must be carefully avoided, however, since it often contains copper or nickel, two metals that are very detrimental to magnesium from the standpoint of corrosion resistance.

*Dipping and Pouring.*—A ladle of special design (Fig. 1) must be used to ensure proper separation of the metal from flux and the delivery of clean metal to the mould. The essential features of this ladle are the parting sweep, retaining shield, and underfeed pouring spout. The sweep is used to part the film of flux covering the surface of the metal in the pot and to permit the dipping of clean metal. Oxide films that form on the surface of the metal in the ladle are held back by the retaining shield. The entrance to the underfeed pouring spout is a short distance from the bottom of the pouring ladle and is provided with a flange, thus retaining in the ladle any small amount of flux that may have been dipped with the metal.

Prior to pouring, the ladle is preheated and cleaned by washing in the flux underneath the metal at the bottom of the pot. After inverting and draining the ladle, it is rinsed two or three times with metal. This is accomplished by parting and skimming back the flux from a small area on the surface of the metal. The edge of the ladle is now held slightly below the surface, whereupon clean metal flows into the ladle. Part of this metal is poured through the spout and the balance is poured rapidly out of the back of the ladle. The clean ladle is then filled with metal for casting as previously described in rinsing. If the flux film does not automatically reform as the ladle is lifted from the metal, the exposed surface is protected by sprinkling with powdered flux.

Surface oxidation of the metal in the ladle is minimised by dusting on a mixture of sulphur and ammonium fluoride salts. Any excess metal in the ladle, above that required for the casting, is poured back into the pot near its circumference. The ladle can be used repeatedly until fouled by adhering magnesium oxide, whereupon it is cleaned in flux.

When pouring a mould, the lip of the ladle is held quite close to the mouth of the sprue and the stream of metal is maintained as steady as possible to minimise turbulence and entrapping of gas. When the casting must be poured hot or when a large sprue is required, the surface of the metal in the sprue may start to burn. Such fires, or those caused by accidents such as runouts or spills on the foundry floor, are readily extinguished by covering with ordinary moulding sand.

The lowest possible pouring temperature should always be used as this will ensure sounder castings with maximum physical properties and will help to reduce melting losses. Temperature control can occur in the pot or in the ladle, depending on whether a single type of casting or a variety

FIG. 1.—TYPE OF CASTING LADLE USED FOR MAGNESIUM ALLOYS.

of castings requiring different temperatures are being poured. Iron-constantan thermo-couples are very satisfactory. These are prepared by welding a constantan wire to the inside tip of a closed thin-walled iron tube. Open couples which expose the constantan to the molten metal should not be used.

### Fettling

Castings are rough-trimmed to remove sprues, gates, and risers; sand-blasted; and given a first inspection prior to heat treatment. Final clean-up generally follows the heat treating operations. Band saws, made from 20-gauge spring temper steel with 4 teeth per in., are operated at a speed of approximately 4,000 ft. per min. Power hack-saws should have 10 teeth per in. and hand hack-saws 14 teeth per in. Single-cut files are recommended and the type known as "body worker's" files are quite satisfactory for heavy work. Portable electric or pneumatic chippers, rotary files, and grinders are used to good advantage. Medium-hard grinding wheels (K to M for alundum) are recommended. A grain size of approximately 20 is satisfactory for foundry snagging operations, while a grain size of 30 to 46 is best for more accurate work.

Tools used on magnesium alloys should not be used for other metals to avoid the danger of sparks. This is particularly true with grinders due to the inflammability of the powder. Special precautions should, therefore, be taken to see that all skim gates and core wires are removed from the castings before grinding and that the wheels do not touch steel inserts. Operators' clothing should be of smooth cloth with no pockets or cuffs in which dust can collect. The grinding wheels and the floor around them should likewise be kept free from dust, preferably through the use of a suction exhaust system. If proper precautions are observed, the fire risk is small and if ignition should occur, the flame will be confined to a minimum of material. Ordinary moulding sand will quickly extinguish any fire that does start. Graphite, table salt, or cast-iron borings should be used in case of fire in the machine shop or around equipment that might be damaged by the abrasiveness of sand.

### Welding and Soldering

Welding and soldering of castings are not as common practices in the magnesium foundry as with some other metals, although these operations may be used to repair small surface defects in unstressed sections of certain types of castings. In acetylene welding, the casting should be heated to 315 to 400 deg. C. The filler rod should be of the same general composition as the casting and a flux should be used (Dow Flux No. 45, Alcoa Flux No. 22, etc.). The completed welds should be thoroughly cleaned in the chrome-pickle solution (see below) to remove any adhering flux.

Castings to be soldered should be thoroughly cleaned by wire-brushing, chipping, or filing so as to present a clean surface to which the solder can bond. They are then preheated to 150 to 205 deg. C. and the solder vigorously puddled with a sharp-pointed steel tool until it has alloyed with the magnesium. Suitable soldering materials include 90 per cent. cadmium—10 per cent zinc, or 60 per cent. cadmium—30 per cent. zinc—10 per cent. tin. The former is less brittle but requires a somewhat higher temperature.

### Painting

Painting is the most practical surface finish for magnesium castings where appearance and protection are important. Chemical finishes have been developed, but they are more important as preliminary treatments for painting than as decorative coatings. The successful painting of magnesium alloy castings offers no unusual difficulties where approved materials are used and good painting practice is observed. Oxide films and dirt are generally removed mechanically by sand blasting or wire brushing. Oil and grease are removed by washing with a solvent, such as carbon tetrachloride or petrol, or are removed by treatment in hot alkaline cleaners. Cleaned castings are then given the chrome-pickle treatment. This consists of a ½- to 2-minute dip in an aqueous solution containing 1.5 lbs. of sodium bichromate and 1.5 pints of concentrated nitric acid per gallon of solution. This bath becomes depleted on use but its efficiency can be restored by proper additions of bichromate and acid. The bath should be discarded after it has been rejuvenated four or five times. Upon removal from this bath, the castings are allowed to drain for a few seconds and then thoroughly washed in hot water. This treatment improves the corrosion resistance of the metal and gives an excellent "tooth" which increases the adhesion of subsequent paint coatings.

The selection of the primer is very important in view of the fact that all representatives of a given class of paints do not show the same service performance. Vehicles with maximum adhesion and maximum imperviousness to water should be selected where service conditions are severe. Baking primers and finishes have excellent adhesion and are, therefore, recommended for small castings or wherever they can be applied. Zinc chromate primers meeting (American) Navy Specification P-27 should be used on large castings in service near salt water or continuous moist air. The latter constitute the best all-round primers and should be used where the type of service is unknown. The choice of surfacer and finish coats is likewise important, although perhaps not so exacting. A good

quality oil paint or enamel is satisfactory for interior work while full synthetic and oil-base synthetic enamels represent the better class of products for outdoor service or near the sea coast.

### Heat Treatment

Most of the magnesium sand casting alloys now being used commercially are amenable to heat treatment with marked improvements in mechanical properties. Both the solution and

TABLE I.—*Magnesium Alloy Ingot for Remelting.*

| Alloy. | Mg. Per cent. | Al. Per cent. | Mn. Min. Per cent. | Zn. Per cent. | Cu. Per cent. | Cd. Per cent. | Si. Max. Per cent. | Other impurities.* Max. Per cent. |
|---|---|---|---|---|---|---|---|---|
| C-11 | Remainder | 8.0–9.0 | 0.18 | — | 0.04 max. | — | 0.2 | 0.3 |
| C-12 | ,, | 9.4–10.6 | 0.13 | — | 0.04 ,, | — | 0.2 | 0.3 |
| C-13 | ,, | 11.5–12.5 | 0.13 | — | 0.04 ,, | — | 0.2 | 0.3 |
| C-14 | ,, | 5.5–6.5 | 0.18 | 2.7–3.3 | 0.04 ,, | — | 0.2 | 0.3 |
| C-15 | ,, | 1.7–2.3 | 0.20 | — | 3.3–4.7 | 1.7–2.3 | 0.2 | 0.3 |

* Nickel, max. 0.02 per cent.

TABLE II.—*Magnesium Alloy Sand Castings.*

| Alloy. | Mg. Per cent. | Al. Per cent. | Mn. Min. Per cent. | Zn. Per cent. | Cu. Per cent. | Cd. Per cent. | Si. Max. Per cent. | Other impurities.* Max. Per cent. |
|---|---|---|---|---|---|---|---|---|
| C-11 | Remainder | 7.8–9.2 | 0.15 | 0.3 max. | 0.05 max. | — | 0.5 | 0.3 |
| C-12 | ,, | 9.0–11.0 | 0.10 | 0.3 ,, | 0.05 ,, | — | 0.5 | 0.3 |
| C-13 | ,, | 11.2–12.8 | 0.10 | 0.3 ,, | 0.05 ,, | — | 0.5 | 0.3 |
| C-14 | ,, | 5.3–6.7 | 0.15 | 2.5–3.5 | 0.05 ,, | — | 0.5 | 0.3 |
| C-15 | ,, | 1.5–2.5 | 0.15 | 0.3 max. | 3.0–5.0 | 1.5–2.5 | 0.5 | 0.3 |

* Nickel, max. 0.03 per cent.

the precipitation methods are used, depending on properties required. The solution heat treatment (H.T. Table III) of the Mg-Al-Mn alloys consists of 16 hrs. heating at 410 deg. C. followed by a quench. It increases the tensile strength, toughness, and percentage elongation of the alloys. The smaller percentage aluminium in the Mg-Al-Mn-Zn alloys permits the use of a lower temperature and this is desirable to avoid the hot-short temperature zone occasioned by the presence of zinc.

The ageing or precipitation heat treatment (H.T.A. Table III) is given to the solution heat treated material and is substantially complete after 16 hrs. at 175 deg. C. This treatment raises the yield strength and hardness of the alloys with a lowering of ductility and toughness. Properties intermediate between those of the solution heat treated and the fully aged conditions can be obtained by giving the alloy a partial or short-time precipitation heat treatment. This partial ageing is not used extensively, however, because of the practical difficulties encountered with furnace charges consisting of various sized castings with both thick and thin sections.

Accurate temperature control is very important, particularly with the solution heat treatment which is carried out at a temperature close to the softening point of the alloy. Electrically heated ovens equipped with automatic temperature control and fans that give reversals in direction of the circulating atmosphere ensure the proper temperature regulation.

### Defects, their Causes and Prevention

Most of the troubles encountered in the magnesium foundry are similar in nature and remedy to the corresponding difficulties met in the production of castings from other types of alloys. Where differences do exist, they can usually be traced directly or indirectly to the lightness and chemical reactivity of magnesium.

*Dross.*—Dross in castings is usually due to the pouring of dirty metal (incomplete washing with flux); to improper or insufficient skimming action in the gates; to the use of few large rather than numerous small gates; and to high pouring temperatures.

*Burned Spots.*—Burned spots are generally due to insufficient sand addition agent or to wet and hard rammed sand. Such troubles are overcome by the addition of more protective agent to the heap or facing; by dusting sulphur on the surface of the mould; by surface drying the mould; or by the use of smaller gates so as to give a more uniform distribution of heat in the mould.

*Blow-Holes.*—Blow-holes are usually caused by dirty metal, improper gating, or improperly prepared sand. Dirty metal is more viscous than clean metal and so retards the escape of entrapped gas. The gates should, therefore, be so arranged that the metal enters the mould with a minimum of turbulence and mechanical entrapping of gas. Hard rammed moulds, particularly from wet sand, and wet or dirty chills may result in surface blows sometimes mistaken for shrinks.

*Pin-Holes.*—Pin-hole porosity is closely associated with other troubles, such as dross, burns, and blows, and is probably due to somewhat similar causes. The more important factors that aid in its elimination are the pouring of clean metal from a ladle held close to the mouth of the sprue; the use of properly tempered sand containing sufficient protective agent; and proper gating for maximum skimming and minimum agitation of the metal. Tilting and venting of moulds, particularly for flat castings, often aids in the elimination of this defect.

*Shrinks.*—Shrinks may appear as surface depressions or as porous spots. Shrinkage cavities seldom occur except in the case of very heavy sections. Surface shrinks can generally be eliminated by the use and proper placement of risers and chills; by a change in gating to permit a lower casting temperature and a more uniform feeding and solidification of the casting. Blows caused by the use of wet or dirty chills or by hard rammed moulds may be readily mistaken for surface shrinks.

*Porous Spots.*—Porous spots are those sections where shrinkage has resulted in a multitude of small, often microscopic, cracks rather than in the formation of a few large cracks or pronounced surface shrinks. These defects are aggravated by oxidation nitridation of the spongy metal, particularly during heat treating operations. These porous spots often penetrate a considerable distance toward the interior of the casting and appear as grey coloured spots on fractured surfaces.

## PROPERTIES AND APPLICATIONS

### Chemical Control Limits

The strength characteristics of these alloys are determined primarily by their aluminium content. Small percentages of zinc are added to improve the corrosion resistance and certain physical properties, but the amount of zinc must be kept relatively low to avoid hot-shortness, particularly during heat treatment. The best combinations of properties are obtained with alloys containing 8 to 12 per cent. of aluminium or of aluminium plus zinc. Alloys with less than 8 per cent. of added metal have relatively poor casting characteristics and low yield strength and hardness, while alloys with more than 12 per cent. of added metal are too brittle for most purposes.

Manganese should be present in all magnesium casting alloys in amounts ranging from 0.1 to 0.4 per cent., that is, in amounts approximating the solubility of manganese in the liquid alloy. These percentages of manganese have little or no effect on the physical properties of the alloys but very materially improve their corrosion resistance, particularly towards salt water.

Since copper and nickel have a very deleterious effect on the corrosion resistance, all metal handling operations, particularly remelting, must be carefully controlled so as to prevent contamination. Alloy C-15, however, purposely contains a large percentage of copper to yield a material with high thermal conductivity, but this advantage is gained at the sacrifice of corrosion resistance. Small amounts of silicon exert

(*Concluded on page* 202.)

TABLE III.—*Physical Properties of Magnesium Alloy Sand Castings.*

| Property. | C-11 As cast | C-11 H.T. | C-12 H.T. | C-12 H.T.A. | C-13 H.T.A. | C-14 As cast | C-14 H.T. | C-14 H.T.A. | C-15 As cast |
|---|---|---|---|---|---|---|---|---|---|
| Tensile strength, tons per sq. in. (min. to avg.)* | 10.2–11.6 | 12.5–15.1 | 12.5–14.3 | 12.5–15.1 | 12.0–12.9 | 10.7–12.0 | 13.4–15.6 | 14.3–17.5 | 9.3–10.7 |
| Yield strength, tons per sq. in. (perm. set 0.2 per cent.) | 5.0 | 5.0 | 5.3 | 8.4 | 9.3 | 5.0 | 5.0 | 8.4 | 3.1 |
| Modulus of elasticity, lbs. per sq. in. × $10^6$ | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 | 6.5 |
| Elongation, per cent. in 2 in. (min. to avg.) | 3–5 | 6–10 | 5–7 | 0–2 | 0–0.5 | 4–6 | 6–11 | 2–5 | 3–6 |
| Brinell hardness, 10-mm. ball, 500 kg. load | 49 | 48 | 52 | 70 | 78 | 49 | 51 | 68 | 40 |
| Specific gravity .. .. | 1.80 | 1.80 | 1.81 | 1.81 | 1.82 | 1.83 | 1.83 | 1.83 | 1.86 |
| Weight per cub. in.—lbs.. | 0.065 | 0.065 | 0.066 | 0.066 | 0.066 | 0.066 | 0.066 | 0.066 | 0.067 |
| Patternmakers' shrinkage, in. per ft. | $\frac{5}{16}$ | $\frac{5}{16}$ | $\frac{5}{16}$ | $\frac{5}{16}$ | $\frac{5}{16}$ | $\frac{5}{16}$ | $\frac{5}{16}$ | $\frac{5}{16}$ | $\frac{5}{16}$ |
| Solidification range, deg. C. (approx.) | 605–435 | 605–435 | 600–435 | 600–435 | 575–435 | 623–398 | 623–398 | 623–398 | 640–565 |
| Electrical resistivity (microhms per cm.³ at 20 deg. C.) | 13.0 | 15.0 | 17.5 | 14.0 | 14.0 | 11.5 | 14.0 | 12.5 | 6.5 |
| Endurance limit, lbs. per sq. in. (R. R. Moore Machine, 500 mil. rev.) | 7,000 | 7,000 | 10,000 | 9,000 | 9,000 | 10,000 | 10,000 | 10,000 | 6,000 |
| Coefficient of thermal expansion per deg. F × $10^6$, (65–750 deg. F.) | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |

* Tension values determined on standard ½-in. diameter A.S.T.M. separately cast specimens.

# The Baby Cupola

## ITS POTENTIALITIES AND TECHNIQUE*

By GUY HÉNON

Users' specifications for cast irons, when they are exacting, do not always involve considerable tonnages. As a result, a foundry to-day has to prepare, in a single melt, several widely differing qualities of iron, each having to conform within narrow limits to the tolerances stipulated. Obviously, and the fact has been remarked upon on several occasions, in practice it is very difficult, with an ordinary cupola, to obtain at one and the same time reasonable costs, a high-duty cast iron to buyer's specification, and a short delivery time with a small tonnage, as many clients demand of ironfounders. Many producers, therefore, have at their disposal, in addition to the ordinary cupola, melting equipments which enable them to produce in small quantities a metal of known good quality at a price which, if not low, is at least acceptable. These melting plants are the crucible, the small oil-fired rotating furnace, the electric radiation furnace, and finally the baby cupola. It is the last named with which this article is concerned, and it will be shown that it fits in very well with the requirements noted above.

### Low Costs

Lighting-up and running are very simple, and are quickly effected. The thermal efficiency of the baby cupola is equal to that of the large cupola, but the expense of bed coke is less.

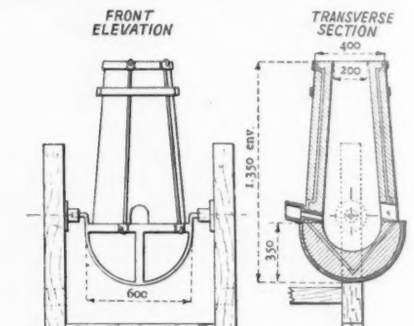



FIG. 1.—BABY CUPOLA USED BY RÉAUMUR FOR MALLEABLE CAST IRON.

Where several different quality irons are to be melted, the amount of "change-over" iron will be small, and will, therefore, be easily taken care of by the actual tonnage paid for.

### Small Tonnages

The very low starting-up costs allow the production of limited quantities of iron in the baby cupola under favourably economic conditions. Some of these baby cupolas are worked on the basis of 100 kg. melts. The iron produced with these conditions is of normal quality, which would not be the case if so small a quantity were melted in a full-sized cupola.

### Reduced Delivery Time

The possibility of making small melts eliminates the necessity of waiting for an accumulation of several small orders for any particular grade of iron. These orders, if urgent, can be fulfilled as and when they are received. Further, the ease of starting-up and running enable the baby cupola to be put into commission at the most favourable time for prompt delivery—for instance, with a very urgent order, at the moment when the moulds have just been closed. The baby cupola, in fact, can be worked in the interval between the tapping of the ordinary cupola or even at the same time.

### High-quality Iron of Exact Composition

The technical advantages of the baby cupola are, in general, less known than its economic advantages; yet it is possible to produce cast irons of precise chemical composition and very high quality. In fact, in addition to the ease of separating the charges, a baby cupola results in less chemical and physical alteration to irons charged therein than would be the case in a cupola of larger capacity. In this connection, the following figures relate to a baby cupola of 40 cm. internal diameter:—

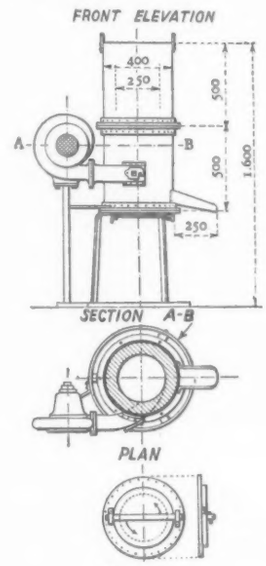



FIG. 2.—GIRARDET CUPOLA. OUTPUT, ABOUT 200 KG. PER HR.

*Carbon Pick-up.*—A charge made up wholly of low carbon pig-iron containing 2.5 to 2.7 per cent. C was tapped from the cupola with a carbon content varying from 2.9 to 3.2 per cent.

A mixture of mild steel turnings and medium-phosphorus iron resulted in an iron carrying 2.6 to 2.8 per cent. carbon.

A mixture made up of two-thirds mild steel and one-third high phosphorus iron yielded iron with 2.3 to 2.6 per cent. carbon.

The same charges melted into a large-sized cupola without a receiver and with normal blowing undergo carburisation of about 0.3 per cent. above those just cited.

*Silicon and Manganese Losses.*—The successive analyses of a phosphoric iron remelted a large number of times in a baby cupola have previously been noted by the author in a Paper read before the French Foundrymen's Association. It is interesting to point out that, while the iron retains a normal composition and structure, that is to say, during the first melts, the losses in silicon and manganese remain relatively small. The losses over the first five melts of 3.8 per cent. for silicon and 9.5 per cent. for manganese are considerably lower than the losses generally encountered under identical conditions with a cupola of larger dimensions.

*Sulphur Pick-up.*—In the course of the same experiments it required nine successive meltings in order for the sulphur content, which initially was 0.029 per cent., to exceed 0.10 per cent. As a corollary to previous observations, it is permissible to state that the mechanical qualities of a high-strength pig-iron remelted in a baby cupola undergo alteration of less important order than that which results from melting in a large cupola. Practical experience confirms this theory. It can, therefore, be said that with the baby cupola irons can be produced the quality of which is distinctly superior to those of irons produced by an ordinary cupola.

### Practical Limitations of Baby Cupolas

The use of these plants is restricted because of the following considerations:—

One can only pour small castings with a weight of the order of 100 kg.

The small hourly production does not provide facilities for the execution of sizeable orders. This plant, therefore, can only be envisaged as "doubling" a larger cupola, its scope being limited to the meeting of urgent orders and producing small castings of high-quality cast irons.

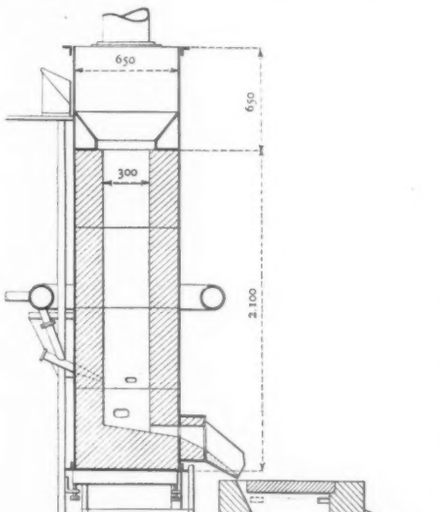



FIG. 3.—CUPOLA INSTALLED AT THE FOUNDRY TECHNICAL INSTITUTE AT AIX-LA-CHAPELLE. OUTPUT, ABOUT 400 KG. PER HR.

The iron tapped is not always of perfect homogeneity when the charges themselves are heterogeneous. With charges of steel-mix iron one meets with differences of 0.3 per cent. in the silicon contents of castings poured from the same melt. It will be shown later how this variation, which is too great for certain applications, can be reduced.

Finally, the running of the baby cupola and its maintenance present certain difficulties which are not always insurmountable.

### Choice of a Baby Cupola

The ironfounder wishing to instal a baby cupola can turn to a specialist who will deliver an efficient apparatus at a very modest price. If, on the other hand, he is governed by strict economic considerations, he can construct it himself. In the following notes, and the accompanying illustrations, are given hints capable of guiding the ironfounder in his choice on the essential construction details. This account, it will be understood, has been limited to the pecu-

* Extracted from an article published in "La Fonte."

liarities of the baby cupola. It should therefore be taken only as supplementing, or on certain points applying, data already published on this subject, regarding ordinary cupolas, in particular the Papers by Ronceray.

### General Form and Size of Baby Cupolas

The essential characteristic of these plants is a small output, hence a small internal section and consequently a reduced blast. It is not possible for a workman to get into the interior of

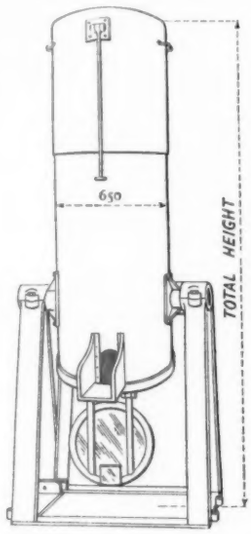



FIG. 4.—WHITING CUPOLA FOR EXPERIMENTAL FOUNDRY.

the cupola to carry out repairs. This must be taken into account, and use made of one of the two arrangements below:—

(1) Short cupola, measuring 2 metres max. from top to bottom. Repairs can then be made by introducing the arm and shoulder at one of the two ends. This length of 2 metres is not too short, and there are users of baby cupolas who have gone even below this without any real inconvenience.

(2) Cupola built up of several sections placed one above the other. These sections can be dismantled in a number of ways, the following arrangements being customary.

An upper part capable of being raised by rams or jacks and a lower part mounted on a truck capable of being moved away after the top has been raised.

An upper part which can be drawn away on a truck or on a roller path after raising.

Several circular sections which can be dismantled and reassembled after repair by the simple manœuvring of an overhead crane, as with the cope of a mould.

In many cases the cupola terminates at the level of the charging mouth. Where possible it is advisable to provide above it a shaft to eliminate fumes and protect the workmen from the flames which are much in evidence when the cupola height is small.

The diameter of the melting equipment should not exceed 50 cm. Some ironfounders have made it smaller, approaching the dimensions of the apparatus used by Réaumur, of which the diameter was about a foot. The baby cupola successfully employed by Girardet has a diameter of 25 cm. with a total height of 1 metre. On the other hand, in the technical Press, and especially in America, one finds examples of baby cupolas with diameters ranging from 30 to 45 cm.

The cupola in the experimental foundry of the Foundry Research Centre has a 40 cm. diameter and gives excellent results. This diameter is definitely recommended for a plant intended to meet industrial requirements.

The height above the bottom plate of the cupola depends upon local conditions and generally can be 70 cm. The sand bed is 12 cm. thick. The tuyere level is as low as possible, taking into consideration the largest castings to be made, to reduce the time the iron remains in the well. The distance of about 25 cm. between the bed and the bottom of the tuyere is suitable in most cases. The slag hole is located slightly beneath the level of the tuyere and opposite the tap hole.

### Tuyeres

Some builders provide several tuyeres on their baby cupolas. This arrangement allows of a symmetrical blast but favours the formation of a "crown." As long as the cupola diameter is under about 50 cm. the author prefers a single tuyere, which gives very good results and simplifies considerably the building up of the cupola casing by cutting down the wind box.

The piping should, as far as possible, incorporate a bend permitting observation of the tuyere and poking. It is advantageous if the tuyere be sufficiently large to allow a workman's arm to be inserted. One can then make up, from the tuyere, the bed and the tap hole, which dispenses with the provision of a lighting up hole.

The tuyere should have a section at least equal to an eighth of the cupola section. This corresponds to a round tuyere of 14 cm. diameter for a 40 cm. cupola.

### Blast

For a 40 cm. cupola an air feed of about 500 cub. m. per hr. is suitable. A great blast is unnecessary, even when low-carbon irons have to be produced. The pressure in the belt in the vicinity of the tuyere should be between 120 and 200 mm. water gauge.

If the cupola height is small, the pressure must be kept down to 120 to 150 mm., otherwise there is abundant sparking from the mouth. If conditions dictate, the blast can be derived from a branch from the air belt of a large cupola. This saves the purchase of a fan, but at the risk of irregular working, because the reduction of volume and pressure of the blast is difficult to secure in a constant and exact manner.

### Cupola Shell

The external dimensions of the cupola are only of small consequence if it is lined with a plastic refractory, which material the author recommends. One can then, without inconvenience, use ring plates, so that, when shaped, their diameter is at least 70 cm. for an internal diameter of 40 cm. These plates, if desired, can be made of cast iron. In this case it is an advantage from the point of view of moulding to replace them by square boxes, even using suitably sized moulding boxes which will be rammed with plastic refractory so as to avoid joints, if it be desired to make a cupola easily dismantled.

### Refractory Lining

In the majority of cases it is best to make this of plastic refractory. Good quality refractory must be used, prepared in a sand mill and used with the minimum of water compatible with good cohesion. It is packed by rammer around a suspended template so formed as to provide a guide to ensure concentricity. Ramming is carried out by a hand or pneumatic rammer; it should be as hard as possible.

The template can be replaced by a simple wooden framework, representing approximately

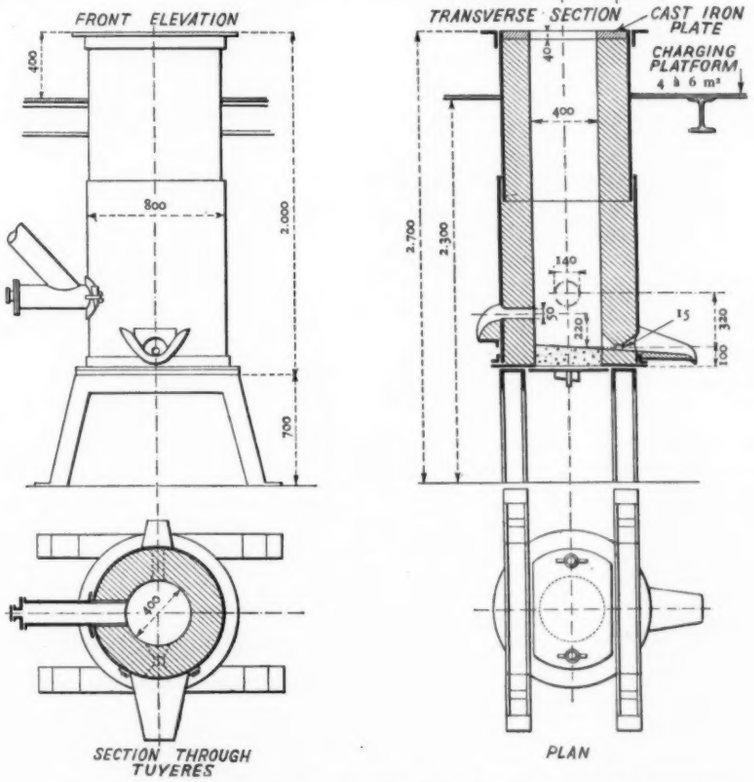



FIG. 5.—BABY CUPOLA IN THE EXPERIMENTAL FOUNDRY AT THE FOUNDRY RESEARCH CENTRE. OUTPUT, ABOUT 500 KG. PER HR.

the internal profile of the cupola. This is dismantled after ramming or simply left in place to be burnt away. The refractory is dried slowly first by wood, then by coke fire.

This lining, after each melt, receives essential repairs. It is not worth devoting too much time to repairing, because it is more expeditious completely to reline the cupola when it is at all seriously worn. Actually, this task can be accomplished in a few hours by an experienced worker.

The bed is made up exactly in the same way as with large cupolas. The finishing off is carried out through the tuyere, as explained above.

### Operating the Baby Cupola

For a 40 cm. cupola the charge is about 100 kg., with 10 to 12 kg. of coke, varying with the nature of the metal charged. The limestone charge weighs 3 to 4 kg. It is useful to add fluorspar or glass, so as to assure the regular running-off of the slag and the cleanliness of the refractory at the end of the melt. This addition, however, should be limited to the last few charges. The coke should be broken into pieces of 60/100 mm.

If the metal charge is heterogeneous, there is reason for maximum breaking-up. Pat Dwyer advises for the coke, and without doubt for the iron too, pieces "as large as eggs." Réaumur went further and specified pieces as large as crowns (coins). The difficulty of breaking is an important reason to give preference to homogeneous raw materials. In general an electrically smelted pig-iron carefully analysed represents the ideal.

Large pieces can then be charged without trouble. Charging should be done without roughness, for the lining is relatively weak. The charges should be arranged methodically in order to avoid scaffolding, which is very prone to occur and contributes to the rapid destruction of the refractory. When scaffolding occurs despite the precautions adopted, invariably it takes place very close to the mouth, because of the small height of the cupola, and it is an easy matter to break it down with the aid of a poker.

Constant inspection of the tuyere, to avoid slag or iron running into it, should be observed. The cupola well is quickly filled, because of its small dimensions.

The above hints, added to the standard rules for the running of cupolas, will enable the iron-founder to produce regularly an iron of definite composition and sufficiently hot to pour quite thin castings in mixtures with little "life" (pearlitic iron, for example).

### A Practical Application of the Baby Cupola

The author cites the example of melting the austenitic Ni-Cu-Cr iron Ni-Resist in the baby cupola. The properties of this metal are well known. They include heat resisting properties, resistance to most forms of corrosion, a degree of malleability in the as-cast state and certain electrical and magnetic properties. The obtaining of these qualities is governed by a definite chemical composition which carries considerable percentages of special additions (more than 20 per cent. of the total being nickel, copper and chrome).

Melting is accomplished generally starting with ingots of Ni-Resist, this method having been shown the most exact and economic. For the preparation of the ingots one can use the crucible, the small rotating oil furnace, the electric furnace or the cupola.

Melting by these equipments, provided operations are carefully controlled, results in little alteration to the metal. Invariably the carbon content, which is about 3.0 per cent. in the mix, remains about this value only when the ingots are cupola-melted. With the other melting plants varying carbon losses are noted, it being possible to lower the total carbon to 2.0 per cent. The "life" of the metal then becomes much lower, in order to allow the successful running of the thinnest castings.

The cupola is therefore of interest in this case because austenitic is quite separate from ordinary irons, and special melts are necessary as a result. This is possible, under the best technical and economic conditions, if there is at hand a cupola conforming to the output envisaged, which in most cases involves small quantities only.

The use of a baby cupola is therefore particularly appropriate; it provides a means of securing practically perfect results as the following analysis of Ni-Resist ingots remelted in one of these cupolas shows:—T.C., 2.92; Si, 2.25; Mn, 1.46; S, 0.020; P, 0.062; Ni, 12.20; Cu, 6.14; Cr, 1.90 per cent.

The same raw iron remelted in the crucible with the re-use of runners, etc., gives carbon contents of the order of 2.0 to 2.1 per cent., the remainder of the composition being much the equivalent.

### Conclusions

The melting of small quantities of high-quality irons can be advantageously carried out in the baby cupola (about 40 cm. internal diameter). The raw material used must be of one type, homogeneous, and of exact composition and properties. Provided the plant has been well built (by a specialist or the founder himself) and is well run, the fabrication of these irons will be speedy, economic, and their quality will be improved compared with the same irons melted in the full-sized cupolas.

## Catalogues Received

**Tipped Tools.** It is seldom that folders are much more than ornamental, designed to create an interest which will provoke inquiries for further information. One received from Edgar Allen & Sons, Limited, of Imperial Steel Works, Sheffield, goes much further than that, and actually within its eight pages contains quite a mass of technical data. It speaks of Stag Major superweld tools and one picture shows a group designed for roll trimming. They have a very different appearance from the pre-war type, which were square in section and carried longitudinal grooves, the feeding being by tapping with a hammer.

**Industrial Process Ventilation.** In publication 1246, the Sturtevant Engineering Company, Limited, of 147, Queen Victoria Street, London, E.C.4, have drawn extensively on various phases of foundry practice to illustrate the application of modern industrial process ventilation. Several references are made to spun pipe manufacture, vitreous enamelling, blueing barrels and chemical laboratories. We can imagine no better means of emphasising the issuing firm's past experience with the problem of fume and dust extraction than by this assembly of annotated photographs into book form. It makes very interesting and convincing reading and is available to our readers on request.

## Skeleton-Pattern Moulding for Pipes

(*Concluded from page* 196.)

and three lower chaplets were used on a pipe of this length, particular attention being given to the position of those at the shoulder of the 90-deg. turn.

The patternshop cost, by the method above outlined, was approximately half that estimated for the provision of a full pattern and pair of intricate-jointed coreboxes. The coremaking, thus simplified, was lowered to about one-third of the estimate; while the actual moulding figures were comparable—regarding the casting as an independent unit—with the average cost per lb. of the bulk of the work in the foundry.—"The Iron Age."

## Report on Recommended Practices for Sand Cast Magnesium Alloys

(*Concluded from page* 199.)

no appreciable effect on the corrosion resistance but as the percentage is increased, the alloys become more brittle. The physical properties of sand castings are given in Table III.

### Development and Field of Use

Magnesium alloy castings are used chiefly in those industries where lightness is essential, that is, where a saving in weight results in a more economical operation of equipment or in a saving of human fatigue. This lightness, coupled with good mechanical properties, gives magnesium alloys strength-weight ratios decidedly superior to those of most other casting alloys. Magnesium alloy castings lose their strength at elevated temperatures, and therefore are best fitted for use at or near room temperatures.

Substantially, all magnesium alloy castings are now produced from the Mg-Al-Mn or the Mg-Al-Mn-Zn alloys. They are amenable to property improvement by solution heat treatment followed by precipitation heat treatment or ageing. Three specific compositions of the Mg-Al-Mn series are being used commercially, the choice of alloy and heat treatment being dependent upon the properties necessary to meet the particular service requirements. Alloy C-12, with its various heat treatments, gives combinations of properties satisfactory for many purposes and, hence, is the most widely used of the three. Alloy C-11 is used where a combination of high tensile strength, percentage elongation, and toughness is required. Alloy C-13 is used in the precipitated or aged condition where maximum yield strength and hardness are desired, even at the expense of toughness. The Mg-Al-Mn-Zn alloys are a more recent development and are being widely used now that they can be successfully heat treated. Alloy C-14 is the most widely used member of this series and bids fair to replace the older Mg-Al-Mn alloys because it offers better combinations of mechanical properties with improved corrosion resistance. Some foundries are using it almost exclusively, while others are conducting extensive tests prior to its adoption. The as-cast properties are satisfactory for a large variety of uses while heat treated castings are used where service requirements demand maximum properties.

Alloy C-15 is a special composition with copper as the chief alloying ingredient. High thermal conductivity is its outstanding characteristic and it was developed primarily for use in pistons for internal combustion engines. The main function of the other alloying ingredients is to improve its strength and foundry characteristics. The corrosion resistance of this alloy is much inferior to that of the other four magnesium casting compositions.

The aircraft industry is the largest consumer of magnesium alloy castings—the more important applications including motor castings, starting equipment, instrument housings, landing wheels, and miscellaneous structural supports and brackets. The portable tool industry is using increasing amounts of sand castings for handles, motor cases, and gear housings in both electric and pneumatic drills, sanders, and the like. Magnesium castings are likewise used in the reciprocating and rapidly moving parts of textile, packaging, and conveying machinery or equipment, as well as in fans, blowers, and rotors. Safety device equipment includes tongs, saw guards, and safety blocks for forming presses. Foundry uses include flasks, pattern plates, core boxes, and core setting jigs.

### A Hard Bronze

For a bronze with a Brinell hardness of the order of 170, a tensile strength of 38 tons per sq. in. and 10 to 14 per cent. elongation, *Cuivre et Laiton* gives the following composition:—Cu, 82.0 to 84.0; Fe, 3.5 to 4.5; Ni, 2.5 to 3.0; Mn, 0.7 to 1.0; and Al, 10.0 to 11.0 per cent.

FOR STRONG CASTINGS WHICH MACHINE PERFECTLY

WHY WORKINGTON IRONS EXCEL

POINT NO. 2

THE FURNACES

CONSTANCY OF BURDEN MEANS CONSISTENCY OF PRODUCT

Workington policy is to work the burden on uniform high-grade raw materials produced largely under our own control, rather than to draw our supplies from miscellaneous sources, which can only lead to inconsistency.
The Derwent Blast Furnace plant has three modern mechanically-charged furnaces, with a total output of 8000 tons a week. The largest furnace has a weekly output of over 3000 tons—one of the largest units in production in this country.
This furnace is often on the same burden for weeks at a time.
To the foundryman this means that, pig for pig, Workington Iron is correspondingly regular and uniform.
You can rely on Workington Irons.

THE UNITED STEEL COMPANIES LTD

WORKINGTON IRON AND STEEL COMPANY, WORKINGTON, CUMBERLAND
Branch of The United Steel Companies Limited

WORKINGTON West Coast Hematite PIG IRONS

W22

# Ni-Resist for Internal Chills

By A. B. EVEREST, Ph.D.

It often happens that in the production of engineering castings the use of internal chills is advantageous in order to ensure dense, sound metal in heavy sections where there is a tendency to drawing and porosity. Practical applications of everyday occurrence are internal bearings in machinery castings, where a dense, good-wearing metal is essential, and also in the bores of the hubs of wheels of all types, where a chill is required frequently to eliminate spongy and open patches which weaken the casting and interfere with the cutting of key-ways. Again, in the mass production of castings the use of internal chills is frequently an important factor in casting to size and so reducing to a minimum the machining and finishing costs of the castings.

Ordinary cast iron, however, is not generally satisfactory for this application, since, owing to its lack of heat resistance and its unsuitable expansion characteristics the internal chills tend to stick, even if they be tapered, and great difficulty is encountered in removing them during fettling. The use of split or collapsible chills is sometimes efficacious, but the method of embodying these chills in a suitable core is frequently costly and cumbersome.

Recent reports from the United States show that in this application Ni-Resist is proving of special interest. The factors which make Ni-Resist so suitable for internal chills are primarily its high coefficient of expansion, and secondly its good resistance to heat with absence of growth and scaling as associated with ordinary cast iron. Experience has shown that when Ni-Resist is used for internal chills the chill quickly reaches approximately the temperature of the surrounding metal whilst the latter is still in a plastic state. Since the expansion of Ni-Resist is, however, about 50 per cent. greater than that of cast iron, the Ni-Resist on cooling contracts away from the casting, thus detaching itself completely from the surrounding metal. Ni-Resist is also heat resisting and does not scale or grow in the same way as plain iron and consequently the chills remain cleaner and can more easily be withdrawn.

A series of laboratory tests was carried out to check up the claims of Ni-Resist for internal chills. The results of these tests are given in Table I.

TABLE I.—*Properties of Internal Chills.*

| Chiller material. | Casting dimensions. In. | | | Shape. | Chiller removable. |
|---|---|---|---|---|---|
| | O. dia. | I. dia. | Length. | | |
| Ni-Resist .. | 4 | 2 | 6 | Not tapered | Easily. |
| Ni-Resist .. | 2½ | 2 | 6 | Not tapered | Easily. |
| Ni-Resist .. | 3½ | 1 | 6 | Not tapered | Easily. |
| Plain iron | 3½ | 1 | 6 | Tapered | No. |
| Ni-Resist .. | 2½ | 1 | 6 | Not tapered | Easily. |
| Plain iron .. | 2½ | 1 | 6 | Tapered | No. |

These tests show conclusively that even when not tapered the Ni-Resist chills were easily removed in all cases, whilst plain iron was firmly fixed in the casting.

### Shot-Blast Nozzles

In practice, Ni-Resist internal chills have been adopted in the production of nozzles as for use in sand- and shot-blast equipment. In this particular application it is found that the Ni-Resist chills give a life of seven to ten times that of the plain iron originally used. It is understood that in applications of this type the chills are prepared by coating them with blacking in order to prevent burning-on.

It will, of course, be appreciated that the actual temperature at which the chill and casting become uniform will depend upon the relative dimensions of the two, and for this reason the Ni-Resist chills, to be effective, must be of proportions within certain limits in relation to the dimensions of the casting. Table I, however, shows that the limits are relatively wide and would cover the average applications of internal chills to engineering castings.

Applications of Ni-Resist chills which have proved efficacious in the United States include, as mentioned above, bearings in machinery castings, hubs for wheels of various types, including gear wheels, nozzles of different types and special gear wheels with internal teeth.

# Correspondence

### Cricket Match

(Institute of British Foundrymen *versus* British Works Managers' Association, Birmingham Branch.)

*To the Editor of* THE FOUNDRY TRADE JOURNAL.

SIR,—With the approval of the President of the Institute of British Foundrymen, Mr. H. Winterton, I have undertaken to organise a team to play a match against a team of the British Works Managers' Association, organised by Mr. W. Todd.

I have arranged for the match to be played on the cricket ground at the King Edward VI School, St. John Street, Lichfield, on Sunday afternoon, September 13, at 2.30.

Any members of the Institute, their ladies, or friends, who care to join us will be welcome. I am arranging for tea to be provided at a moderate charge on the ground, and if any member wishes to join us I should appreciate a line from him, as this would assist me in making the necessary arrangements. I should also be pleased to hear from any member who would like to assist me by playing in the match.—Yours, etc.,

J. E. HURST,
Past-President, Institute of British Foundrymen.

Darlaston Blast Furnaces,
Darlaston.
September 2, 1936.

# Safety Goggles

Quite often fettlers and grinders are working in close proximity to welders, and as they should wear protective goggles under any condition, they might just as well be supplied with a type which affords protection from dangerous light rays. Melters have a bad or good habit (according to the view point) of watching the flames playing around the doors of melting furnaces whilst the metal is melting down or being finished, and these little flames are real sources of "optical" danger, and a new safety goggle is obviously required, even though it does involve the supply of two types—one for actually looking in the furnace and the other for ancilliary work.

It is for the protection of these various workers that Safety Products, Limited, of St. George's House, Hatton Garden, London, E.C.1, have produced a new goggle, which has been submitted for our examination. The design of this goggle embodies several praiseworthy features. In the first place it is light and comfortable to wear, weighing no more than an ordinary pair of spectacles—about 1¼ oz. Chance's "Crookes" lenses, slightly tinted, are fitted, which give adequate protection yet, at the same time, allow

(*Concluded in next column.*)

# The Institute of Vitreous Enamellers

## ANNUAL CONFERENCE

The Third Annual Conference of The Institute of Vitreous Enamellers will be held in Manchester from Friday, October 2, to Sunday, October 4.

A banquet and dance will be held in the Alexandra Suite, Midland Hotel, Manchester, to inaugurate the conference, and the Council feel they can confidently rely upon every individual member giving his personal support, and that he will further ensure the conference's success by inviting friends and associates, especially the ladies, who will be warmly welcomed.

Several prominent leaders of industry, commerce and scientific societies have consented to attend and lend their support. A special visit has also been arranged for the ladies on the Saturday morning, to the mills of one of the best known makers of cotton fabrics in the country.

### Conference Programme

OCTOBER 2.

7 p.m.—Reception by the President of the Institute, Dr. J. W. Mellor, F.R.S., and Mrs. Mellor, at the Midland Hotel, Manchester.

7.30 p.m.—Banquet. (*Evening Dress.*)

9.30 p.m. to 2 a.m.—Dancing in the Alexandra Room to Orlando and his Orchestra. Entertainers:—Ben Mayoh "And of course a Piano"; Tom H. Jackson, "The Man with the Cards."

Dressing rooms will be provided at the Midland Hotel from 6.30 p.m.

OCTOBER 3.

9 a.m. and 9.30 a.m.—Coaches will leave the Midland Hotel for a works visit to The Pilkington Tile & Pottery Company, Limited, Clifton Junction.

9.15 a.m.—A coach will leave the Midland Hotel to visit the mills of Tootal, Broadhurst, Lee & Company, Limited, Sunnyside Mills, Bolton.

This visit has been specially arranged for the ladies and the Committee hope that as many as possible will attend.

1 p.m.—Return to Midland Hotel. Members will make their own luncheon arrangements.

2 p.m.—Technical meeting in Room 108, at the Midland Hotel.

(*a*) Presidential Address.
(*b*) Chairman's Remarks.
(*c*) Paper: "Modern Tendencies in Vitreous Enamelling," by S. Hallsworth.
(*d*) Discussion.

4.30 p.m.—Extraordinary meeting of the Institute.

Business: Revision of Articles of Association.

5 p.m.—Afternoon tea.

OCTOBER 4.

Private-motor rally to Llangollen; further details will be given when the number of members interested is known.

(*Concluded from preceding column.*)

blue prints to be read through them. They afford a wide angle of vision—another factor contributing to safety. The leather sideshields prevent any "flash" reaching the eyes from the side; at the same time these shields, which are ventilated, have a cooling effect on the temples. The cable earsides can be lengthened if necessary to suit the individual wearer, and finally, the frame embodies a "saddle" bridge which does not touch, and therefore cannot rub, the nose. From a personal examination of these goggles we can say that they adequately fulfil the purpose for which they have been designed. The price, we understand, is very moderate.

# CUMMING'S BLACKINGS
# ARE
# THE BEST

*Extract* from daily report by one of our travellers:—

*January 9th, 1936.*

Mr. C..... said,

"I shall send on to you every time. Since we adopted your Blacking the skin of our castings has improved by 100 per cent. Our customers were the first to notice it."

## NEED WE SAY MORE

All our productions are carefully graded, tested and manufactured.

WM. CUMMING & CO., LTD.

**KELVINVALE MILLS, Maryhill, Glasgow, N.W.**
**SUNNYSIDE BLACKING MILLS, Falkirk.**
**WHITTINGTON MILLS, Chesterfield.**
**DEEPFIELDS MILLS, Bilston.**
**STATION CHAMBERS, Middlesbrough.**

# The Week's News in Brief

## Trade Talk

R. & A. MAIN, LIMITED, of Falkirk, are making extensions to their enamelling shop at a cost of £2,000.

JAMES HOWDEN & COMPANY, LIMITED, of Glasgow, are supplying a grit-arresting plant at the Glasgow municipal buildings extension.

THE ENGINEERING EXHIBITS at the Empire Exhibition at Johannesburg will include a representative selection of gear units manufactured by David Brown & Sons (Hudd.), Limited, of Huddersfield.

THE BARROW HEMATITE STEEL COMPANY, LIMITED, are putting down a bore-hole at Bigrigg, at a place where ore was worked on the quarry principle many years ago. The old quarry is not more than 20 ft. deep.

HENRY ROBB, LIMITED, Leith, have received an order from the Dundee, Perth & London Shipping Company, Limited, for a cargo vessel, 223 ft. long, 35 ft. beam, and 15½ ft. moulded depth. Diesel engines will be supplied by the Atlas Diesel Company, Limited.

THE DIRECTORS OF Thomas Blackburn & Sons, Limited, engineers and ironfounders, of Preston, state that, in addition to the heavy bookings which they have in hand for constructional work, they have received contracts for six miles of iron railings from two Corporations.

RUBERY, OWEN & COMPANY, LIMITED, structural and mechanical engineers, of Darlaston, are to embark on a works modernisation scheme. It provides for the extension and rebuilding of several factories, and the installation of up-to-date plant. The scheme will cost about £200,000.

IT IS REPORTED from Helsingfors that a first cargo of about 400 tons of nickel ore will be shipped in the near future from Finland to Swansea. The Mond Nickel Company—a subsidiary of the International Nickel Company of Canada—owns all the shares of Petsamon Nikkeli O/Y.

FOLLOWING THE STARTING of another furnace, the Normanby Ironworks, Middlesbrough, of Pease & Partners, Limited, are now working at capacity. Three furnaces are in operation, but one of them will be damped down in a few weeks' time to facilitate repairs. There are now 31 furnaces in blast on the North-East Coast.

SYNTHETIC RUBBER, made from furnace slag, coal dust or sand, together with some actual liquified rubber and a proportion of vegetable juices, has been manufactured by Mr. Thomas Arnold, of Bradford, and his son. This preparation has been utilised for flooring, non-skid roads, and soles for shoes. It is claimed that the material is 15 to 20 per cent. cheaper to produce than actual rubber, and that it has considerably improved wear-resistance properties.

AS A RESULT of the examinations for the session 1935-36, the following students have been awarded the diploma of the British Foundry School. Distinctions are awarded in each of the four subjects of the examination—Foundry Metallurgy, Foundry Technology, Foundry Management, Foundry Planning and Casting Studies (Ferrous and Non-Ferrous) :—L. Berry, F. P. Birch, J. R. Booth, R. V. Dowle, J. W. C. Johnson, J. L. King, H. C. Newby, R. O. Patterson (distinction in Foundry Planning and Casting Studies, Ferrous and Non-Ferrous), G. H. Rhodes, S. A. Shaat (distinction in Foundry Technology), J. McI. Shand, H. Walton, B.Sc. (distinction in Foundry Management), and M. A. Wardle.

## Pulverised Fuel Equipment at a Derby Foundry

(*Concluded from page* 194.)

an air-break timing starter (seen on the left of Fig. 8) provided with separately mounted push-buttons interlocked with a 31-point shunt regulator.

Interlocking features are provided in other parts of the control gear where necessary.

In concluding this description it may be mentioned that the foundries and associated shops are illuminated by Osira mercury vapour discharge lamps in dispersive reflectors; nearly 100 400-watt units are installed. The black sand used for the moulds responds particularly well to the quality of the Osira light, and the detail of the moulds down to the bottom can be examined more clearly and faults detected more readily. In addition the steam and smoke is penetrated, thus improving visibility during this important operation.

Sincere thanks are due to Ley's Malleable Castings Company, Limited, for their courtesy in allowing the publication of this description with the accompanying illustrations.

## Company Reports

**Ransome & Marles Bearing Company, Limited.**—Dividend of 15 per cent. in respect of the year ended June 30.

**Newton Bros. (Derby), Limited.**—Trading profit, £6,461; rents, dividends on investments, etc., £322; depreciation, £2,287; bank interest, £1,701; directors' fees, £675; income tax, £137; excess of patent gear manufacturing costs over sales for the year, £515; net profit, £1,468.

**Blakey's Boot Protectors, Limited.**—Net profit, £23,261; brought in, £7,966; profit on maturity of life policies, £6,576; preference dividend, £450; to reserve, £1,200; final ordinary dividend of 7½ per cent., making 15 per cent.; carried forward, £13,823. Meeting, September 16.

## Contracts Open

**Oxford,** September 23.—1,600 tons of 6-in., 5-in., 4-in. and 3-in. dia. cast-iron pipes and special castings, for the Town Council. Mr. A. Carstairs, city and waterworks engineer, Town Hall, Oxford. (Fee £3 3s., returnable.)

**Singapore,** November 2.—Brass stop and bib taps, etc., for the Singapore Municipal Water Department. The Department of Overseas Trade. (Reference T.Y. 30,680.)

**Wellington,** September 29.—20-ton motor overhead crane, for the Public Works Department. The Department of Overseas Trade. (Reference T.Y. 30,686.)

## New Companies

*(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)*

**Ouzledale Foundry Company, Limited,** Ouzledale, Barnoldswick, via Colne. Capital, £500. Director: J. Ashby.

**British Metallicoat, Limited,** 152-156, Great Portland Street, London, W.1.—Capital, £1,000. Directors: W. T. Grose and E. W. Franklin.

## Output of Pig-Iron, Steel and Finished Products

The British Iron and Steel Federation in its Statistical Bulletin for July, 1936, states that pig-iron production in the United Kingdom in July amounted to 665,600 tons, compared with 644,100 tons in June and 547,300 tons in July, 1935. The total of 4,414,300 tons for the first seven months of the year shows an increase of 18.7 per cent. over the corresponding period of 1935. Steel production in July amounted to 974,100 tons, compared with 965,900 tons in June and 803,300 tons in July, 1935. The total of 6,717,500 tons for the first seven months of the year shows an increase of 19.9 per cent. over the corresponding period of 1935. According to returns received from 145 firms employing 135,922 workpeople, the average weekly earnings per head in June amounted to £3 5s. 10d., compared with £3 7s. 3d. in May and £3 5s. 6d. in April.

## Personal

MAJOR CHARLES PRATT has joined the board of Blackstone & Company, Limited, of Stamford. He has had a wide experience of engineering in many parts of the world.

MR. JOHN MACVICAR, until recently foreman engineer with the Fairfield Shipbuilding & Engineering Company, Limited, Glasgow, has joined the staff of the English Electric Company, Limited, of Rugby.

COL. WILLIAM TOZER was elected Master Cutler of the Cutlers' Company of Hallamshire, Sheffield, last week. Col. Tozer, who will succeed Sir Samuel Roberts, comes of an old Sheffield family which has long been associated with the steel trade. He, like his father and his grandfather, has been associated with the firm of Steel, Peech & Tozer, Limited. He is a member of the Council of the Sheffield Chamber of Commerce.

MR. J. GRAY BUCHANAN has just completed 50 years' association with William Jacks & Company, Winchester House, Old Broad Street, London, having entered the Glasgow office of the firm on September 6, 1886. After spending seven years in the Glasgow office of the firm, Mr. Buchanan went to London as private secretary to Dr. Jacks, and to manage the London business. Eight years later—in 1901—he became a partner, and in 1907, on Dr. Jacks's death, and Mr. Bonar Law—a partner of the firm—having retired from business to devote himself to a political career, Mr. Buchanan became the senior partner of the firm. Apart from the many social activities with which he is connected, Mr. Buchanan also serves on the London Committee of the Scottish National Development Council.

### Wills

| | |
|---|---|
| WILSON, CHARLES, managing director of Chas. Wilson, Limited, ironfounders, of Heeley, Sheffield ... ... ... | £15,151 |
| UREN, WILLIAM, of Moseley, chairman of Uren, Rogers & Company, Limited, iron and steel merchants ... ... | £2,720 |
| HADCOCK, LIEUT.-COL. SIR ALBERT G., F.R.S., a director of Sir W. G. Armstrong Whitworth & Company, Limited, Vickers Armstrongs, Limited, and other companies ... ... ... | £33,702 |

## Obituary

THE DEATH HAS OCCURRED of Mr. Robert Douglas, who until his retirement about two years ago, was a member of the firm of Robert Douglas & Sons, of Montrose. He was 76 years of age.

MR. WM. H. NICHOLLS, President of Wm. H. Nicholls & Company, Inc., of Long Island, New York, has died recently. He was the founder of the firm of Wm. H. Nicholls Company, Inc., and in addition to being a foundry production consultant, invented many valuable machines. Especially during the years of the world war and the years immediately following were his services sought by foundries seeking to increase their production to meet the ever-increasing demand. He successfully solved this problem, and to-day a great number of the larger foundries in the United States, Canada and Europe attribute their success in producing large quantities of good castings at a minimum cost to the recommendations made by Mr. Nicholls. He was born and educated in New York City, and as a boy of 16 years entered the foundry industry as an apprentice moulder, continuing his studies by attending evening school. He studied engineering at the Pratt Institute of Brooklyn. In 1910 he started in business for himself, and thereby laid the foundation for the company of which he was, at the time of his death, President.

## Forthcoming Events

SEPTEMBER 14-18.
*Institute of Metals* :—Annual Conference in Paris.

SEPTEMBER 16-25.
International Foundry Congress and Foundry Exhibition, in Düsseldorf.

SEPTEMBER 21-26.
*Iron and Steel Institute* :—Autumn Meeting in Düsseldorf.

# THE "ROCKET" CORE MAKING MACHINES

## HELP to . . .

## REDUCE COSTS AND MAKE SOUND CASTINGS

*for*

## BRITISH

— STEEL FOUNDERS —
GREY IRON FOUNDERS
MALLEABLE FOUNDERS
NON-FERROUS FOUNDERS

*used in the manufacture of—*

Electric Cookers. Gas Cookers. Motor Transport Vehicles. Aeroplanes. Internal Combustion Engines. Cast Iron Bath Fittings. Brass Water Service Fittings. Sluice Valves. Gas Valves. Rain Water Castings. Textile Machinery. Lawn Mowers. Ship Building, etc., and General Engineering Castings.

## FOUNDRY ENGINEERS LIMITED

HALIFAX ——— YORKS.

Telephone: Halifax 61459. Telegrams: "FEL," Halifax.

# Raw Material Markets

In some districts it is difficult to place new business for supplies of iron and steel owing to the fact that makers are already heavily committed over a considerable period and have no desire to add to their order-books for the time being. Consumers of pig-iron are endeavouring to build up large stocks in order to protect themselves against a possible shortage towards the end of the year. Producers have only small stocks and these are being rapidly diminished, as deliveries are in excess of current output. The pressure for deliveries in all sections of the steel market continues unabated and consumption is at a high level.

## Pig-Iron

**MIDDLESBROUGH.**—New business in the Cleveland area is confined to small parcels which are required for supplementing contract supplies. Makers have been able to reduce the arrears against existing contracts to some extent, but the surplus available for export remains very small. Pig-iron consumers would be only too willing to contract for supplies well into next year, but makers are dubious as to the trend of prices, which are likely to be raised owing to increasing costs of production. However, this will not be done before the end of the current year. Present prices of No. 3 Cleveland G.M.B. are 75s. per ton in the Middlesbrough and Falkirk areas, 77s. on the North-East Coast, and 78s. in Glasgow, a premium of 2s. 6d. per ton being required for No. 1 quality.

The current output of East Coast hematite remains inadequate to meet the demand and the pressure for deliveries is very heavy. An additional blast furnace for the production of special hematite was blown in recently at Pease & Partners' Normanby works, but the output will be readily taken up. Current quotations are based on mixed numbers at 85s. per ton delivered on the North-East Coast, 90s. 6d. Sheffield and 96s. Birmingham, all these figures being subject to the recognised rebate of 5s. per ton.

**LANCASHIRE.**—Some consumers in this area are contracted for supplies over the first quarter of 1937, but the amount of new buying is not heavy at the present time. Deliveries are on a good scale. Large tonnages are regularly being taken up by the light-castings founders, the machine-tool makers, the heavy electrical engineers, the jobbing founders and the general engineers. Offers of Staffordshire and Derbyshire brands of No. 3 iron are on the basis of 83s. per ton for delivery in the Lancashire price zone, Northants at 81s. 6d., and Derbyshire forge iron at from 78s. to 80s., according to the class of consumer. Hematite is quoted at 93s. 6d. per ton for West Coast and from 93s. for East Coast, with Scottish No. 3 iron on offer around 91s., all delivered equal to Manchester.

**MIDLANDS.**—A few contracts have been arranged in ordinary foundry pig-iron up to the end of March, 1937, but makers generally are well sold and are reluctant to increase their commitments. The present quotations are 77s. 6d. per ton for Northants No. 3 and 80s. for Derbyshire, Lincolnshire and North Staffordshire No. 3, delivered to Birmingham and Black Country stations, and subject to a small sliding-scale rebate to large consumers. Users are well employed and the outlook in most sections is very satisfactory. Producers are having to draw supplies from their meagre stocks in order to keep users from going short. The demand for forge pig-iron has improved of late, but the price remains at 5s. per ton below No. 3 foundry. Special irons continue to be well inquired for, the general engineers and the jobbing founders being well situated for work. Values vary considerably, according to the analysis and the geographical situation of the source of supply, and are as follow:—Medium-phosphorus, 82s. 6d. to 90s.; low-phosphorus, 92s. 6d. to 100s.; refined iron, £6 10s. to £8 10s., delivered local stations. The hematite market remains firm and the demand is very heavy. West Coast mixed numbers are quoted at £4 17s., East Coast No. 3 £4 16s., and Welsh mixed numbers £4 15s. 6d., these figures being subject to 5s. rebate and inclusive of delivery to Birmingham and South Staffordshire stations. An additional 1s. 6d. per ton is charged if delivered into works.

**SCOTLAND.**—The pig-iron market in this area is exceptionally strong and makers are well sold up to the end of the year. Owing to the rising costs of production makers are reluctant to sell further ahead. Prices are unchanged, No. 1 being at 81s. 6d. and No. 3 foundry at 79s., f.o.t. furnaces. Further consignments of Russian and Indian basic iron have arrived and will be taken up immediately. Active conditions continue to prevail among light-castings founders. Prices of Cleveland iron are unchanged, No. 3 foundry being at 75s. f.o.t. Falkirk, and 78s. f.o.t. Glasgow. East Coast, West Coast and Scottish hematites are quoted at 85s. 6d., less 5s. rebate, with basic, British and Indian, at 75s., less 5s. rebate, all f.o.t. steelworks.

## Coke

Values on the foundry-coke market are very firm and users are anxious to cover their winter requirements in view of the distinct possibility of increased prices later on in the autumn. For delivery in Birmingham and district, best Durham coke is quoted from 40s. to 42s. 6d. per ton, with Welsh coke from 39s. 6d. to 50s.

## Steel

Great activity in all sections of the steel industry is assured for a period well into next year, states the official report of the London Iron and Steel Exchange. With the completion of the holiday season, the demand for most descriptions is increasing, and there are indications that the autumn requirements will be on a heavy scale. There has been no relaxation in the activity in the semi-finished steel department, and all the producing works are working at capacity. Although consumers are for the most part well bought, they have shown an inclination to place further contracts in anticipation of an increased demand for their products. Specifications against contracts are being pressed upon the works, and the latter are finding it difficult to meet their customers' requirements. In the finished steel section of the market, signs of the beginning of the autumn expansion in trade are already apparent. Practically all the steelworks are producing at capacity. Most of them are in arrears with deliveries, and the periods required for the execution of orders are lengthening. Export business has shown some improvement, and the volume of inquiry from oversea markets has been active.

## Scrap

Inquiries on the Cleveland market have been more frequent recently and merchants are not disposed to sell ahead at 57s. 6d. per ton for heavy steel scrap. Heavy machinery scrap is at 65s. to 67s. 6d., while heavy foundry metal is on offer at 62s. 6d. to 65s. All descriptions of scrap are receiving a steady demand on the Midlands market. Most of the business transacted is confined to small parcels for early delivery. Prices are unchanged, with heavy machinery metal in cupola sizes at 70s. per ton, good heavy at 65s., and clean light cast iron at 52s. 6d. to 55s. Short, heavy steel, as used in the foundries, is firmer at 65s. per ton delivered works. Firm conditions prevail on the Scottish market and consumption is on a good scale. First-quality heavy steel melting scrap remains at 57s. 6d. per ton, with basic, or heavy iron and steel scrap mixed, in furnace sizes, at 52s. 6d. Wrought-iron piling scrap is taken up at 67s. 6d. to 69s., with special quality at a few shillings per ton more. Machinery cast-iron scrap, in pieces not exceeding 1 cwt., remains at 67s. 6d. to 70s., with ordinary cast iron, to the same specification, at 64s. to 65s. per ton, delivered f.o.t. consumers' works.

## Metals

**Copper.**—Firm conditions have prevailed on this market during the past week and consumption is on a good scale. Rearmament plans throughout the world are resulting in the use of a substantial tonnage of copper and this is one of the reasons why the market has not been so markedly affected by the holiday season as is usual at this time of the year. A fair demand is reported on industrial account from the United States.

Daily market prices :—

*Cash.*—Thursday, £38 8s. 9d. to £38 10s.; Friday, £38 12s. 6d. to £38 13s. 9d.; Monday, £38 15s. to £38 16s. 3d.; Tuesday, £38 17s. 6d. to £38 18s. 9d.; Wednesday, £38 8s. 9d. to £38 10s.

*Three Months.*—Thursday, £38 13s. 9d. to £38 15s.; Friday, £38 17s. 6d. to £38 18s. 9d.; Monday, £39 1s. 3d. to £39 3s. 9d.; Tuesday, £39 2s. 6d. to £39 3s. 9d.; Wednesday, £38 13s. 9d. to £38 15s.

**Tin.**—The obscure outlook on this market has kept business very quiet recently. Buyers in the United States also are not showing much initiative, but the tinplate mills are working at about 90 per cent. of standard capacity. According to the statistics issued by Mr. W. H. Gartsen (Henry Rogers, Sons & Company) the world's visible supplies at the end of August were 14,425 tons, which is an increase of 1,425 tons as compared with the total at the end of the previous month. The carry-over in the Straits Settlements was 1,597 tons against 2,142 tons, while the carry-over at the Arnhem (Holland) smelter was 750 tons against 822 tons.

Metal Exchange quotations were as follow :—

*Cash.*—Thursday, £187 to £187 5s.; Friday, £188 15s. to £189 5s.; Monday, £191 10s. to £191 15s.; Tuesday, £191 15s. to £192 5s.; Wednesday, £194 to £194 10s.

*Three Months.* — Thursday, £184 10s. to £184 12s. 6d.; Friday, £186 5s. to £186 10s.; Monday, £189 2s. 6d. to £189 5s.; Tuesday, £189 10s. to £189 15s.; Wednesday, £191 15s. to £192

**Spelter.**—The brass trade remains the chief consumer of spelter in this country and its prospects are excellent, but apart from this source of consumption the market is quiet. Firmer conditions have prevailed in the United States. There have been no further developments in connection with the re-establishment of the Zinc Cartel.

Official quotations were as follow :—

*Ordinary.*—Thursday, £13 7s. 6d.; Friday, £13 7s. 6d.; Monday, £13 10s.; Tuesday, £13 12s. 6d.; Wednesday, £14.

**Lead.**—New business has been on a good scale during the past week and the market has retained its firm appearance. The position as regards supplies is believed to be very tight. At the present time there is a slight lull in the United States, but a resumption of business is expected in the near future.

Day-to-day quotations :—

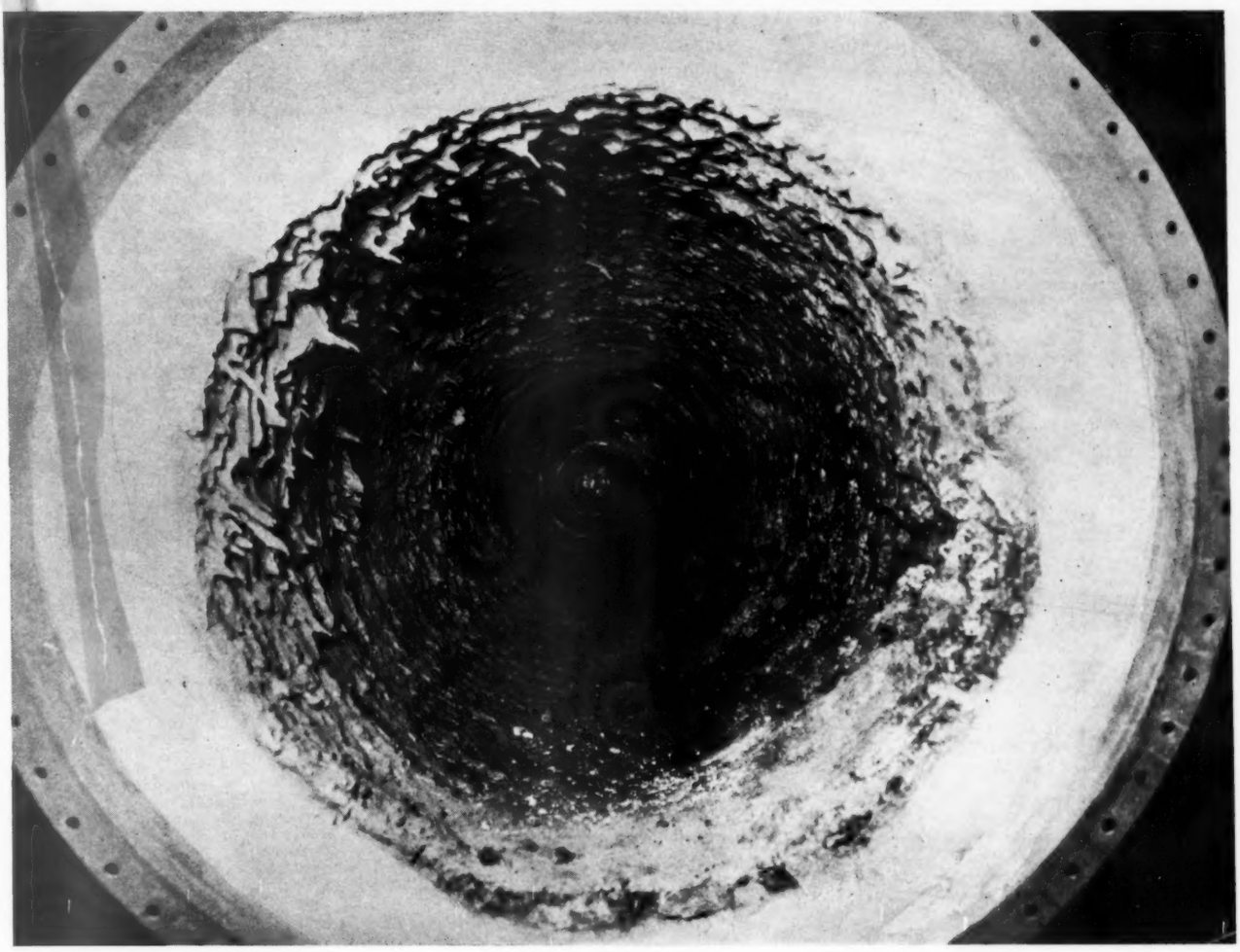
*Soft Foreign (Prompt).*—Thursday, £17 6s. 3d.; Friday, £17 8s. 9d.; Monday, £18; Tuesday, £18 2s. 6d.; Wednesday, £17 18s. 9d.

## Publication Received

**Aluminium Foundry Data.** Published by the British Aluminium Company, Limited, Adelaide House, King William Street, London, E.C.4.

This delightfully written book is fortunately at the disposal of our readers on request. The first section deals with the making of copper and zinc and silicon aluminium casting alloys, together with some notes on heat-treatable alloys. A table follows which lists ten alloys and gives their general composition, the proof stress, elastic limit, ultimate stress, elongation and Brinell hardness on both sand and chill cast specimens. All these and many other alloys are stocked by the British Aluminium Company, which certainly relieves the foundry executives of much preliminary work. For those firms which use their own alloys, there is a section specially devoted to their interests, and zinc, tin, magnesium, copper and nickel are all included.

Melting practice is the subject of the next section and a wealth of practical information is disclosed, whilst in a following section, which deals with casting, the fundamentals governing the necessity for strict temperature control are rightly emphasised. The notes on gates, risers and chills get to the root of the problem—and a problem well stated, as is this one, is more than half solved. Rightly, the anonymous author has refrained from giving examples and has wisely confined his remarks to basic principles. The booklet closes with a few notes on knocking-out and dressing.



# 950 tons of metal melted—

The above photograph shows the condition of an 04 grade Albino lining in a 5-ton Brackelsberg furnace after 255 heats. You will observe the lining has worn back evenly and it is still approximately 8" in thickness. The 04 grade is specially produced for rotary furnaces, but there are other grades for lining cupolas, converters and ladles. This photograph is reproduced by courtesy of James Howden and Company (Land) Ltd.

## ALBINO

### ROTARY FURNACE LINING MATERIAL

***Please write for further particulars to the sole manufacturers:***

## GENERAL REFRACTORIES LIMITED,

**Genefax House, Sheffield, 10**

Telephone: Sheffield 31113 (6 lines) Telegrams: "Genefax, Sheffield"

MANUFACTURERS OF HEAT RESISTING AND HEAT INSULATING MATERIALS OF EVERY DESCRIPTION.

# RAW MATERIALS—PRICE LIST

**(Wednesday, September 9, 1936)**

## COPPER

| | £ s. d. |
|---|---|
| Standard cash | 38 8 9 |
| Three months | 38 13 9 |
| Electrolytic | 43 0 0 |
| Tough | 41 15 0 |
| Best selected | 42 5 0 |
| Sheets | 70 0 0 |
| India | 52 10 0 |
| Wire bars | 43 10 0 |
| Ingot bars | 43 10 0 |
| H.C. wire rods | 47 0 0 |
| Off. av. cash, Aug. | 38 5 11¼ |
| Do., 3 mths., Aug. | 38 11 3⅜ |
| Do., Sttlmnt., Aug. | 38 5 9 |
| Do., Electro, Aug. | 42 13 0 |
| Do., B.S., Aug. | 42 5 0 |
| Do., wire bars, Aug. | 42 18 6 |
| Solid drawn tubes | 10½d. |
| Brazed tubes | 10¾d. |
| Wire | 6½d. |

## BRASS

| | |
|---|---|
| Solid drawn tubes | 9½d. |
| Brazed tubes | 11¾d. |
| Rods, drawn | 8¼d. |
| Rods, extd. or rlld. | 5d. |
| Sheets to 10 w.g. | 8d. |
| Wire | 7½d. |
| Rolled metal | 7½d. |
| Yellow metal rods | 5d. |
| Do. 4 × 4 Squares | 5¾d. |
| Do. 4 × 3 Sheets | 5¾d. |

## TIN

| | £ s. d. |
|---|---|
| Standard cash | 194 0 0 |
| Three months | 191 15 0 |
| English | 194 5 0 |
| Bars | 196 5 0 |
| Straits | 198 0 0 |
| Australian | 194 0 0 |
| Eastern | 194 7 6 |
| Banca | 197 0 0 |
| Off. av. cash, Aug. | 183 17 7½ |
| Do., 3 mths., Aug. | 180 17 1½ |
| Do., Sttlmt., Aug. | 183 17 9 |

## SPELTER

| | £ s. d. |
|---|---|
| Ordinary | 14 0 0 |
| Remelted | 13 5 0 |
| Hard | 11 10 0 |
| Electro 99.9 | 16 0 0 |
| English | 14 10 0 |
| India | 12 10 0 |
| Zinc dust | 19 10 0 |
| Zinc ashes | 4 5 0 |
| Off. aver., Aug. | 13 12 10½ |
| Aver. spot, Aug. | 13 10 6¾ |

## LEAD

| | £ s. d. |
|---|---|
| Soft foreign ppt. | 17 18 9 |
| Empire | 18 17 6 |
| English | 20 0 0 |
| Off. average, Aug. | 16 16 3¾ |
| Average spot, Aug. | 16 15 5¼ |

## ALUMINIUM

| | |
|---|---|
| Ingots | £100 to £105 |
| Wire | 1/3 to 1/4 lb. |
| Sheet and foil | 1/2 to 1/4 lb. |

## ZINC SHEETS, &c.

| | £ s. d. £ s. d. |
|---|---|
| Zinc sheets, English | 24 0 0 to 24 10 0 |
| Do., V.M. ex-whse. | 24 0 0 to 24 10 0 |
| Rods | 25 10 0 |

## ANTIMONY

| | £ s. d. £ s. d. |
|---|---|
| English | 64 10 0 to 65 10 0 |
| Chinese, ex-whse. | 54 0 0 |
| Crude, c.i.f. | 26 0 0 |

## QUICKSILVER

| | £ s. d. £ s. d. |
|---|---|
| Quicksilver | 12 7 0 to 12 17 6 |

## FERRO-ALLOYS AND STEEL-MAKING METALS

| | |
|---|---|
| Ferro-silicon— | |
| 25% | 8 17 6 |
| 45/50% | 11 10 0 to 12 15 0 |
| 75% | 16 12 6 to 17 17 6 |
| Ferro-vanadium— | |
| 35/50% | 12/8 lb. Va. |
| Ferro-molybdenum— | |
| 70/75% carbon-free | 4/6 lb. Mo. |
| Ferro-titanium— | |
| 20/25% carbon-free | 9d. lb. |
| Ferro-phosphorus, 20/25% | £21 to £22 |
| Ferro-tungsten— | |
| 80/85% | 3/1½ lb. |
| Tungsten metal powder— | |
| 98/99% | 3/3 lb. |
| Ferro-chrome— | |
| 2/4% car. | 33 0 0 |
| 4/6% car. | 21 10 0 |
| 6/8% car. | 21 0 0 |
| 8/10% car. | 21 0 0 |
| Ferro-chrome— | |
| Max. 2% car. | 33 10 0 |
| Max. 1% car. | 36 5 0 |
| Max. 0.50% car. | 37 5 0 |
| 70% carbon-free | 9½d. lb. |
| Nickel—99.5/100% | £200 to £205 |
| "F" nickel shot | £184 0 0 |
| Ferro-cobalt, 98/99% | 6/3 to 6/9 lb. |
| Metallic chromium— | |
| 96/98% | 2/5 lb. |
| Ferro-manganese— | |
| 76/80% loose | £11 5 0 to 11 15 0 |
| 76/80% packed | £12 5 0 to 12 15 0 |
| 76/80% export | £10 5 0 |
| Metallic manganese— | |
| 94/96% carbon-free | 1/3 lb. |

Per ton unless otherwise stated, basis 2-ton lots.

## HIGH-SPEED TOOL STEEL

| | |
|---|---|
| Finished bars, 14% tungsten | 2s. 0d. |
| Finished bars, 18% tungsten | 2s. 9d. |

Per lb. net, d/d buyers' works.

Extras—

| | |
|---|---|
| Rounds and squares, 3 in. and over | 4d. lb. |
| Rounds and squares, under ½ in. to ¼ in. | 3d. lb. |
| Do., under ¼ in. to 3/16 in. | 1/– lb. |
| Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in. | 3d. lb. |
| Do., under ½ in. × ¼ in. | 1/– lb. |
| Bevels of approved sizes and sections | 6d. lb. |

Bars cut to length, 10% extra.

## SCRAP

| | £ s. d. £ s. d. |
|---|---|
| South Wales— | |
| Heavy steel | 3 2 0 to 3 3 0 |
| Mixed iron and steel | 2 19 0 to 3 0 0 |
| Heavy cast iron | 2 16 0 to 3 0 0 |
| Good machinery | 3 2 0 to 3 4 0 |
| Cleveland— | |
| Heavy steel | 2 17 6 |
| Steel turnings | 2 0 0 |
| Heavy cast iron | 3 2 6 to 3 5 0 |
| Heavy machinery | 3 5 0 to 3 7 6 |
| Midlands— | |
| Light cast-iron scrap | 2 12 6 to 2 15 0 |
| Heavy wrought iron | 3 5 0 |
| Steel turnings | 2 0 0 |
| Scotland— | |
| Heavy steel | 2 17 6 |
| Ordinary cast iron | 3 4 0 to 3 5 0 |
| Engineers' turnings | 2 2 6 |
| Cast-iron borings | 1 17 6 |
| Wrot-iron piling | 3 7 6 to 3 9 0 |
| Heavy machinery | 3 7 6 to 3 10 0 |

London—Merchants' buying prices, delivered yard.

| | £ s. d. |
|---|---|
| Copper (clean) | 30 0 0 |
| Brass | 19 10 0 |
| Lead (less usual draft) | 16 0 0 |
| Tea lead | 11 10 0 |
| Zinc | 8 10 0 |
| New aluminium cuttings | 74 0 0 |
| Braziery copper | 28 0 0 |
| Gunmetal | 29 0 0 |
| Hollow pewter | 138 0 0 |
| Shaped black pewter | 105 0 0 |

## PIG-IRON

| | |
|---|---|
| N.E. Coast (d/d Tees-side area)— | |
| Foundry No. 1 | 77/6 |
| ,, No. 3 | 75/– |
| ,, No. 4 | 74/– |
| Forge No. 4 | 74/– |
| Hematite No. 1 | 85/6* |
| Hematite M/Nos. | 85/–* |
| N.W. Coast— | |
| Hem. M/Nos. d/d Glas. | 85/6* |
| ,, d/d Birm. | 97/–* |
| Malleable iron d/d Birm. | 125/– |
| Midlands (d/d Birmingham dist.)— | |
| Staffs No. 4 forge | 77/– |
| ,, No. 3 fdry. | 80/– |
| Northants forge | 74/6 |
| ,, fdry. No. 3 | 77/6 |
| ,, fdry. No. 1 | 80/6 |
| Derbyshire forge | 77/– |
| ,, fdry. No. 3 | 80/– |
| ,, fdry. No. 1 | 83/– |
| Scotland— | |
| Foundry, No. 1, f.o.t. | 81/6 |
| ,, No. 3, f.o.t. | 79/– |
| Cleveland No. 3, Glasgow | 78/– |
| ,, ,, Falkirk | 75/– |
| Scottish hem. M/Nos. d/d | 85/6* |
| Sheffield (d/d district)— | |
| Derby forge | 74/6 |
| ,, fdry. No. 3 | 77/6 |
| Lincs forge | 74/6 |
| ,, fdry. No. 3 | 77/6 |
| W.C. hematite | 91/–* |
| Lancashire (d/d eq. Man.)— | |
| Derby fdry. No. 3 | 83/– |
| Staffs fdry. No. 3 | 83/– |
| Northants fdry. No. 3 | 81/6 |
| Cleveland fdry. No. 3 | 83/– |
| Dalzell, No. 3 (special) | 102/6 to 105/– |
| Glengarnock, No. 3 | 91/– |
| Clyde, No. 3 | 91/– |
| Monkland, No. 3 | 91/– |
| Summerlee, No. 3 | 91/– |
| Eglinton, No. 3 | 91/– |
| Gartsherrie, No. 3 | 91/– |
| Shotts, No. 3 | 91/– |

* Subject to a rebate of 5s. per ton under certain conditions.

## FINISHED IRON AND STEEL

*Usual district deliveries for iron; delivered consumer's station for steel.*

| Iron— | £ s. d. £ s. d. |
|---|---|
| Bars (cr.) | 10 10 0 |
| Nut and bolt iron | 8 17 6 to 9 7 6 |
| Hoops | 11 7 6 and up. |
| Marked bars (Staffs) f.o.t. | 13 0 0 |
| Gas strip | 11 7 6 and up. |
| Bolts and nuts, ¾ in. × 4 in. | 16 0 0 and up. |
| Steel— | |
| Plates, ship, etc. | 9 7 6 to 9 10 0 |
| Boiler plts. | 9 17 6 to 10 0 0 |
| Chequer plts. | 11 0 0 |
| Angles | 9 0 0 |
| Tees | 10 0 0 |
| Joists | 9 7 6 |
| Rounds and squares, 3 in. to 5½ in. | 10 0 0 |
| Rounds under 3 in. to ⅜ in. (Untested) | 9 7 0 |
| Flats—8 in. wide and over | 9 5 0 |
| ,, under 8 in. and over 5 in. | 9 10 0 |
| Rails, heavy | 8 5 0 to 8 10 0 |
| Fishplates | 12 10 0 |
| Hoops (Staffs) | 10 2 0 |
| Black sheets, 24g. (4-t. lots) | 12 0 0 |
| Galv. cor. shts. ( ,, ) | 14 0 0 |
| Galv. flat shts. ( ,, ) | 14 10 0 |
| Galv. fencing wire, 8g. plain | 15 0 0 |
| Billets, soft | 6 2 6 |
| Billets, hard | 7 2 6 to 7 7 6 |
| Sheet bars | 6 0 0 |
| Tin bars | 6 0 0 |

## PHOSPHOR BRONZE

| | Per lb. basis |
|---|---|
| Strip | 10½d. |
| Sheet to 10 w.g. | 11½d. |
| Wire | 12⅜d. |
| Rods | 11½d. |
| Tubes | 14d. |
| Castings | 12½d. |

Delivery 3cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

## NICKEL SILVER &c.

| | Per lb. |
|---|---|
| Ingots for raising | 7d. to 1/1 |
| Rolled— | |
| To 9 in. wide | 1/1 to 1/7 |
| To 12 in. wide | 1/1½ to 1/7½ |
| To 15 in. wide | 1/1½ to 1/7½ |
| To 18 in. wide | 1/2 to 1/8 |
| To 21 in. wide | 1/2½ to 1/8½ |
| To 25 in. wide | 1/3 to 1/9 |
| Ingots for spoons and forks | 7d. to 1/3½ |
| Ingots rolled to spoon size | 10d. to 1/6½ |
| Wire round— | |
| to 10g. | 1/4½ to 1/11½ |

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

## AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

| | Dols. |
|---|---|
| No. 2 foundry, Phila. | 21.31 |
| No. 2 foundry, Valley | 19.50 |
| No. 2 foundry, Birm. | 15.58 |
| Basic, Valley | 19.00 |
| Malleable, Valley | 19.50 |
| Grey forge, Valley | 19.00 |
| Ferro-mang. 80%, seaboard | 75.00 |
| O.-h. rails, h'y, at mill | 36.37½ |
| Billets | 30.00 |
| Sheet bars | 30.00 |
| Wire rods | 38.00 |
| | Cents. |
| Iron bars, Chicago | 1.80 |
| Steel bars | 1.95 |
| Tank plates | 1.90 |
| Beams, etc. | 1.90 |
| Skelp, grooved steel | 1.80 |
| Steel hoops | 1.95 |
| Sheets, black, No. 24 | 2.50 |
| Sheets, galv., No. 24 | 3.20 |
| Wire nails | 2.10 |
| Plain wire | 2.40 |
| Barbed wire, galv. | 2.60 |
| Tinplates, 100-lb. box | $5.25 |

## COKE (at ovens)

| | |
|---|---|
| Welsh foundry | 30/– to 32/6 |
| ,, furnace | 24/– to 25/– |
| Durham foundry | 24/6 |
| ,, furnace | 21/6 |
| Scotland, foundry | 30/– |
| ,, furnace | 25/– to 26/– |

## TINPLATES

f.o.b. Bristol Channel ports.

| | | |
|---|---|---|
| I.C. cokes | 20×14 per box | 18/9 |
| ,, | 28×20 ,, | 37/6 |
| ,, | 20×10 ,, | 26/9 to 27/– |
| ,, | 18¾×14 ,, | 19/6 |
| C.W. | 20×14 ,, | 15/6 to 15/9 |
| ,, | 28×20 ,, | 33/9 to 34/– |
| ,, | 20×10 ,, | 22/6 to 22/9 |
| ,, | 18⅞×14 ,, | 15/3 to 15/9 |

## SWEDISH CHARCOAL IRON & STEEL

| | £ s. d. £ s. d. |
|---|---|
| Pig-iron | £6 0 0 to £7 0 0 |
| Bars-hammered, basis | £16 0 0 to £16 10 0 |
| Bars and nail-rods, rolled, basis | £15 15 0 to £16 0 0 |
| Blooms | £10 0 0 to £12 0 0 |
| Keg steel | £25 0 0 to £28 0 0 |
| Faggot steel | £18 0 0 to £23 0 0 |
| Bars and rods dead soft, st'l | £10 0 0 to £12 0 0 |

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

### DAILY FLUCTUATIONS

**Standard Copper** (cash)

| | £ s. d. | |
|---|---|---|
| Sept. 3 .. | 38 8 9 dec. | 1/3 |
| „ 4 .. | 38 12 6 inc. | 3/9 |
| „ 7 .. | 38 15 0 „ | 2/6 |
| „ 8 .. | 38 17 6 „ | 2/6 |
| „ 9 .. | 38 8 9 dec. | 8/9 |

**Electrolytic Copper**

| | £ s. d. | |
|---|---|---|
| Sept. 3 .. | 42 15 0 No | change |
| „ 4 .. | 43 0 0 inc. | 5/- |
| „ 7 .. | 43 0 0 No | change |
| „ 8 .. | 43 0 0 „ | „ |
| „ 9 .. | 43 0 0 „ | „ |

**Standard Tin** (cash)

| | £ s. d. | | |
|---|---|---|---|
| Sept. 3 .. | 187 0 0 dec. | 10/- | |
| „ 4 .. | 188 15 0 inc. | 35/- | |
| „ 7 .. | 191 10 0 „ | 55/- | |
| „ 8 .. | 191 15 0 „ | 5/- | |
| „ 9 .. | 194 0 0 „ | 45/- | |

**Tin** (English ingots)

| | £ s. d. | | |
|---|---|---|---|
| Sept. 3 .. | 187 5 0 dec. | 5/- | |
| „ 4 .. | 189 0 0 inc. | 35/- | |
| „ 7 .. | 191 10 0 „ | 50/- | |
| „ 8 .. | 192 0 0 „ | 10/- | |
| „ 9 .. | 194 5 0 „ | 45/- | |

**Spelter** (ordinary)

| | £ s. d. | | |
|---|---|---|---|
| Sept. 3 .. | 13 7 6 dec. | 1/3 | |
| „ 4 .. | 13 7 6 No | change | |
| „ 7 .. | 13 10 0 inc. | 2/6 | |
| „ 8 .. | 13 12 6 „ | 2/6 | |
| „ 9 .. | 14 0 0 „ | 7/6 | |

**Spelter** (Electro, 99.9 per cent.)

| | £ s. d. | | |
|---|---|---|---|
| Sept. 3 .. | 15 8 9 No | change | |
| „ 4 .. | 15 8 9 „ | „ | |
| „ 7 .. | 15 10 0 inc. | 1/3 | |
| „ 8 .. | 15 12 6 „ | 2/6 | |
| „ 9 .. | 16 0 0 „ | 7/6 | |

**Lead** (soft foreign, prompt)

| | £ s. d. | | |
|---|---|---|---|
| Sept. 3 .. | 17 6 3 inc. | 3/9 | |
| „ 4 .. | 17 8 9 „ | 2/6 | |
| „ 7 .. | 18 0 0 „ | 11/3 | |
| „ 8 .. | 18 2 6 „ | 2/6 | |
| „ 9 .. | 17 18 9 dec. | 3/9 | |

**Lead** (English)

| | £ s. d. | | |
|---|---|---|---|
| Sept. 3 .. | 19 5 0 inc. | 5/- | |
| „ 4 .. | 19 10 0 „ | 5/- | |
| „ 7 .. | 20 0 0 „ | 10/- | |
| „ 8 .. | 20 0 0 No | change | |
| „ 9 .. | 20 0 0 „ | „ | |

## A COMPARISON OF SCRAP PRICES

*Prices of Heavy Steel Scrap (Delivered) in the Principal Districts at the Beginning of Each Month in the Years* 1929–1936.

| Year. | January. | February. | March. | April. | May. | June. | July. | August. | September. | October. | November. | December. | Yearly average. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| *Scotland—* | | | | | | | | | | | | | |
| 1929 .. .. .. | 3 5 6 | 3 7 6 | 3 12 6 | 3 15 0 | 3 15 0 | 3 15 0 | 3 15 6 | 3 16 0 | 3 17 6 | 3 15 0 | 3 12 6 | 3 10 6 | 3 13 1½ |
| 1930 .. .. .. | 3 9 0 | 3 7 6 | 3 5 0 | 3 5 0 | 3 0 6 | 2 15 0 | 2 12 0 | 2 10 0 | 2 13 3 | 2 10 0 | 2 10 0 | 2 10 0 | 2 17 3½ |
| 1931 .. .. .. | 2 7 6 | 2 7 6 | 2 5 0 | 2 5 0 | 2 0 0 | 1 17 6 | 1 17 6 | 1 17 6 | 1 17 6 | 1 15 0 | 2 0 0 | 2 2 6 | 2 1 0½ |
| 1932 .. .. .. | 2 2 6 | 2 2 6 | 2 0 0 | 1 17 6 | 1 17 6 | 1 17 6 | 1 15 0 | 1 15 0 | 1 12 6 | 1 13 0 | 1 12 6 | 1 15 0 | 1 16 9½ |
| 1933 .. .. .. | 1 15 0 | 1 17 6 | 1 18 6 | 1 18 9 | 1 18 0 | 1 17 6 | 1 18 9 | 2 0 0 | 2 2 6 | 2 5 0 | 2 7 6 | 2 8 9 | 2 0 7½ |
| 1934 .. .. .. | 2 8 9 | 2 14 3 | 2 13 0 | 2 13 0 | 2 12 0 | 2 10 0 | 2 10 6 | 2 10 6 | 2 11 0 | 2 10 9 | 2 10 0 | 2 10 0 | 2 11 2 |
| 1935 .. .. .. | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 10 7½ | 2 10 0½ |
| 1936 .. .. .. | 2 12 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 6 | — | — | — | — | — |
| *North-East Coast—* | | | | | | | | | | | | | |
| 1929 .. .. .. | 3 0 0 | 3 2 6 | 3 3 6 | 3 3 6 | 3 3 6 | 3 5 0 | 3 5 0 | 3 5 0 | 3 5 0 | 3 6 6 | 3 5 0 | 3 3 6 | 3 4 0 |
| 1930 .. .. .. | 3 3 6 | 3 3 6 | 3 2 0 | 3 0 0 | 2 17 6 | 2 10 0 | 2 10 0 | 2 7 6 | 2 7 6 | 2 7 6 | 2 5 0 | 2 6 0 | 2 13 4 |
| 1931 .. .. .. | 2 6 0 | 2 6 0 | 2 5 0 | 2 5 0 | 2 2 6 | 2 0 0 | 1 17 6 | 1 17 6 | 1 17 6 | 1 17 6 | 1 17 6 | 2 2 6 | 2 1 2½ |
| 1932 .. .. .. | 2 0 0 | 2 0 0 | 1 15 0 | 1 15 0 | 1 15 0 | 1 15 0 | 1 15 0 | 1 15 0 | 1 15 0 | 1 12 6 | 1 15 0 | 1 17 6 | 1 15 10 |
| 1933 .. .. .. | 2 0 0 | 2 0 0 | 2 5 0 | 2 0 0 | 1 15 0 | 1 17 6 | 2 2 6 | 2 2 6 | 2 3 6 | 2 5 0 | 2 7 6 | 2 7 6 | 2 2 2 |
| 1934 .. .. .. | 2 10 0 | 2 16 0 | 2 10 0 | 2 7 6 | 2 7 6 | 2 10 0 | 2 9 9 | 2 10 0 | 2 10 0 | 2 10 0 | 2 11 6 | 2 11 3 | 2 10 3½ |
| 1935 .. .. .. | 2 11 6 | 2 11 9 | 2 12 0 | 2 12 0 | 2 12 6 | 2 12 6 | 2 12 6 | 2 12 6 | 2 12 6 | 2 12 6 | 2 12 6 | 2 13 9 | 2 12 4½ |
| 1936 .. .. .. | 2 18 0 | 2 17 9¾ | 2 17 6 | 2 17 6 | 2 17 6 | 2 17 9¾ | 2 17 6 | 2 17 6 | — | — | — | — | — |
| *South Wales—* | | | | | | | | | | | | | |
| 1929 .. .. .. | 3 8 6 | 3 10 6 | 3 15 0 | 4 0 0 | 4 0 0 | 3 18 0 | 3 17 6 | 3 17 6 | 3 15 0 | 3 15 0 | 3 12 6 | 3 7 6 | 3 14 9 |
| 1930 .. .. .. | 3 7 6 | 3 6 0 | 3 6 0 | 3 4 0 | 3 2 6 | 2 17 6 | 2 16 0 | 2 15 0 | 2 14 9 | 2 12 6 | 2 12 6 | 2 5 0 | 2 18 3½ |
| 1931 .. .. .. | 2 5 0 | 2 7 6 | 2 7 6 | 2 7 6 | 2 5 0 | 2 2 6 | 2 0 0 | 2 0 0 | 1 18 0 | 2 2 6 | 2 5 0 | 2 7 6 | 2 4 0 |
| 1932 .. .. .. | 2 6 6 | 2 6 0 | 2 5 0 | 2 2 6 | 2 2 0 | 1 19 0 | 1 17 6 | 1 18 6 | 1 18 0 | 1 18 0 | 1 17 6 | 1 18 0 | 2 0 8½ |
| 1933 .. .. .. | 2 0 0 | 2 1 6 | 2 4 0 | 2 3 6 | 2 3 6 | 2 3 0 | 2 5 0 | 2 5 0 | 2 8 0 | 2 10 0 | 2 10 0 | 2 10 0 | 2 5 3½ |
| 1934 .. .. .. | 2 10 0 | 2 16 3 | 2 15 9 | 2 13 9 | 2 14 3 | 2 15 0 | 2 14 3 | 2 14 3 | 2 15 0 | 2 15 6 | 2 15 6 | 2 15 6 | 2 14 7 |
| 1935 .. .. .. | 2 15 6 | 2 15 6 | 2 15 6 | 2 15 6 | 2 15 6 | 2 15 6 | 2 15 6 | 2 15 6 | 2 16 1½ | 2 17 9 | 2 19 8 | 3 1 1½ | 2 16 2½ |
| 1936 .. .. .. | 3 4 3 | 3 5 11¼ | 3 5 8¼ | 3 5 7¼ | 3 5 3 | 3 3 9 | 3 2 10 | 3 2 4¼ | — | — | — | — | — |


WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG

IRON

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

## Notice

**Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-**

***(A remittance should accompany instructions.)***

### SITUATIONS VACANT AND WANTED

FOUNDRY Foreman desires change. Broad experience with machine tool and general engineering castings up to 30 tons; modern production methods. Real live man. M.I.B.F.—Box 860. Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ADVERTISER, a practical Jobbing Moulder, is open to take position of Working Foreman.—Box 884, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN Assistant Foundry to take charge of machine and stump moulders. Must be conversant with up-to-date methods. West Bromwich district. State fully experience and salary required.—Box 886, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY Foreman required for large repetition grey-iron foundry producing castings for the motor trade. Successful applicant would be required to take charge of section in the machine moulding department. Apply stating age, experience, and salary required.—Box 878, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

CORE SHOP Foreman required for highly mechanised core shop producing cores used in connection with the production of castings for the motor trade. Apply stating age, experience, and salary required.—Box 880, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED. — Charge Hand for small mechanical moulding plant. Apply giving full particulars of age, experience, and wages required, to Box 876, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATTERN Plate Maker required for power moulding-machine work. Should be capable of handling job from drawing to finished casting. Write experience and salary required. —PHOSPHOR BRONZE CO., LTD., Chester Street, Birmingham.

### EMPLOYMENT REGISTER.

**Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.**

***Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.***

***Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.***

FOUNDRY Clerk capable of controlling books, buying, correspondence, all office and commercial duties. Thorough technical training, iron and steel and metallurgical knowledge. Sound connection with leading buyers in Scotland for iron, steel and malleable castings. Opportunity for any firm desirous of increasing business, especially in Scotland. Reasonable salary with prospects. (284)

BRASSFOUNDRY Foreman requires position or as Assistant in large foundry. Sound experience with first-class firms with high-pressure castings in gunmetal, phosphor bronze. Dry and green sand. Modern production methods. (285)

### AGENCY

AGENCY required for Silica Bricks in North England and Scotland. Full particulars to Box 890, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

### BUSINESS FOR SALE

FOR SALE as a going concern, Modern Iron Foundry situated in North Lincs, with a capacity of 50 tons per week. The foundry is equipped with one practically new Ultra Rapid Cupola by Alldays & Onions and one small cupola, one 5-ton overhead electric crane, 42 ft. span, and two moulding machines, one Jackman and one Darling & Sellers. Good stock of moulding boxes, two grinders, etc. Excellent river and railway transport.—Apply Box 882, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

### FOR SALE OR TO LET

IRON FOUNDRY.—Well equipped and recently modernised, situated in the heart of an industrial area in the West Riding of Yorkshire, with a capacity of 30/40 tons per week. An appreciable volume of business is assured, and the proposition is an attractive one to the right people. Inspection invited.—Box 830, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C 2.

### MACHINERY

**Tilghman Sandblast Barrel Plants; barrel sizes—60 in. x 40 in.; 36 in. x 20 in.; 20 in. x 30 in.**

**Tilghman Sandblast Cabinet Plants; 4 ft. 6 in. and 3 ft. 6 in. square (one for high pressure 70 lbs. per sq. in.); also small Cabinet 30 in. dia.**

**All complete with Air Compressors, etc.**

**Gas and Air Mixer by Sharpe & Preston, 2-in. outlet.**

**Six Osborne Pneumatic Jolt Press Moulding Machines, size 75J.**

**Three Mumford Yoke Headpress Pneumatic Moulding Machines.**

**Two Herbert Whizzer Sand Disintegrators.**

**Two Brealey Type ditto.**

**Heavy Double-ended Grinding Machines by Rowlands, Luke & Spencer, etc.**

**Hand Moulding Machines by Adaptable Darling & Sellars, Pridmore, Samuelson, etc.**

**500 Electric Motors, Dynamos, Rotary Converters, etc.**

**S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.**

**CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.**

**'Phone: Broadwell 1359.**

## THOS. W. WARD LTD.

Pneu. 12" cyl. PLAIN JOLT-RAM MOULDING MACHINE (Jackman); table 5' square.

Pneu. No. 6 Ajax JOLT-RAM ROLL-OVER MOULDING MACHINE; take 36" x 24" boxes.

5,000' RIVETED TUBING, 20" dia. x ¼" plate.

WIRE ROPES, 1⅛" dia., 360' long.

***Write for "Albion" Catalogue.***

**Grams: "Forward." 'Phone: 23001 (10 lines).**

**ALBION WORKS, SHEFFIELD.**

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & CO., LTD., Station Works, Ecclesfield, Sheffield.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

### MISCELLANEOUS

IRONFOUNDRY in Midlands requires more work. Would consider amalgamation with firm of engineers. Splendid prospects. Quality, deliveries, prices guaranteed.—Box 888, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOR SALE.—Steel Moulding Boxes, various sizes, all complete. £5 per ton f.o.r. Lancashire.—Apply E. HIND, Imperial Works, South Bank, Middlesbrough.

WHY WASTE MONEY by paying too high a price for your Blacking? Blacking of the highest quality, but quoted at very low prices, is obtainable from JACK HIBBERT & COMPANY, LIMITED, T.G. Dept., Octagon Works, Vicarage Road, Battersea, S.W.11. Send for free 1-cwt. sample for testing.

GENUINE Southport Wind Blown Sand, which makes best oil-sand cores. Prompt deliveries by road into works.—JOHN LIVESEY, Sand Merchant, Southport.

### PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1936 edition. Price 42s. cloth bound, 52s. Morocco. Order your copy now.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

**'Phone: 287 SLOUGH**

## MOULDING MACHINES

Two Tabor Modern Jolt Squeeze and Pattern Draw Machines for boxes 20" × 14"; as new. Price £65 each.

One ditto, for 20" square Boxes. Price £70.

Several reconditioned GRIMES Hand Pattern-draw and Turnover Machines. Price £12 each.

One genuine OSBORN Hand Machine. Price £28.

Several nearly new DENBIGH Jolters. CHEAP!

CUPOLETTE, 30" dia., NEW. Price £26.

PLEASE SEND US YOUR ENQUIRIES.

**ALEX. HAMMOND,** *Foundry Machinery Merchant,*
**14, AUSTRALIA ROAD, SLOUGH**
***BUY FROM ME AND SAVE MONEY!***

**SELECT YOUR MACHINE FROM THE**

## LARGEST

**STOCK OF HIGH-CLASS SECONDHAND**

## MOULDING MACHINES

**IN THE WORLD**

*Practical Advice Free*

**C. W. COLEMAN,**
**156, STRAND, LONDON, W.C.2.**